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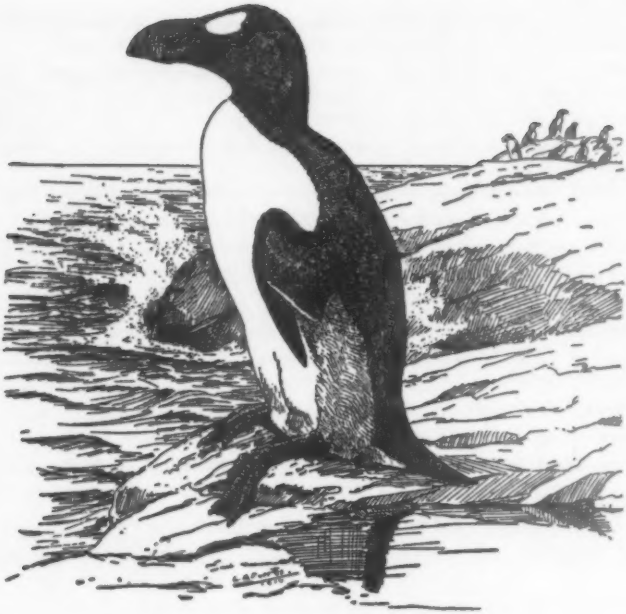

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THE STATUS OF AVIAN SYSTEMATICS AND ITS UNSOLVED PROBLEMS*

BY ERWIN STRESEMANN

BIOLOGISTS all over the world have devoted the year 1958 to the memories of Darwin and Wallace. We ornithologists also should call to our attention the powerful impetus which we have received from the intellectual work of these great men, to whom we owe a better understanding of the origin of the great diversity among birds. Two factors are responsible, according to Darwin's theory, for the ever greater perfection of the living world: variation and selection. I suggest that these same factors are of major importance in the interplay of ideas and concepts. Permanent advances in our scientific understanding we owe likewise to variation and selection.

Variation is the consequence of the individuality of those who work on the same topic. Zoologists differ in their philosophical background, in the extent of their knowledge, in their thoroughness, and in their gift of combination. This variability is certainly displayed to a high degree by the avian systematists. What Max Fürbringer has written about them, will forever remain true: "At various times a few fortunate individuals have existed who were gifted with such an acute insight that it revealed to them intuitively, one might almost say instinctively, this or that systematic relation among related forms without the necessity of laborious investigation." At the other extreme there have been some poor devils who did wrong whatever they did and who were completely lost without methodology.

Survival of the fittest will decide which of the many competing theories will prevail. Only one can finally survive. Each revisor attempts to shorten the struggle by acting as a selective factor. When

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he has to synthesize a modern system of birds he is forced to choose a single one among many conflicting theories, often without having the opportunity of examining thoroughly the arguments of the different authors. I myself have painfully experienced the feelings of a taxonomic compiler, for I developed (1934) an eclectic system of bird classification some 25 years ago. While doing so, I made a few mistakes, as I now realize. Has not the experience of others been the same? On the whole all the avian systems presented in the standard works in this century are similar to each other, since they are all based on Fürbringer and Gadow. My system of 1934 does not differ in essence from those which Wetmore (1951) and Mayr and Amadon (1951) have recommended.

The most obvious differences between the several recent classifications are in the delimitation of the higher categories. Wetmore arranges them in 27 orders, Mayr and Amadon in 28 orders, while I recognized 49 orders (1933–34: 738–853). In other words: I preferred to leave the question of phylogenetic relationship open in many more cases than the authors of the other two systems. Today I would recognize 51 orders (see Appendix).

An answer has tentatively been given now to some of the questions of relationship which I had considered as unsolved; others which seemed to be solved at that time have meanwhile been reopened for discussion. The outsider who reads some of the recent critical discussions may easily get the impression that our conventional system is full of errors. It seems to me, however, that one must apply to many of the newer proposals the same evaluation which was made by Alfred Newton in 1893, who wrote: "Some of the later attempts to systematic arrangement are in my opinion among the most fallacious, and a good deal worse than those they are intented to supersede."

A considerable part of these objections are due to efforts to create an avian system which specifies with great precision the degree of phylogenetic relationship of all groups. The construction of phylogenetic trees has opened the door to a wave of uninhibited speculation. Everybody may form his own opinion on the phylogeny of the higher categories of birds, because, as far as birds are concerned, there is virtually no paleontological documentation which has revealed such important information on the phylogeny as has been the case with the other classes of vertebrates. The investigator of avian phylogeny must rely on indirect clues, which are nearly always ambiguous. It is for this reason that Seebohm (1890) recommended to the systematists to ignore phylogenetic endeavors by the following sentence: "The classification of existing birds is the study of a horizontal section of

the great bird mass of the world, and ought to form a different and distinct system confined to the horizon of the present time." To be honest, we must admit that we mix the horizontal and the vertical system to this very day. It is a concession to the "horizontal section" if, for instance, in a much used contemporary system the "true birds" are divided into two superorders—the Impennes or Penguins and the Neognathae or Typical birds—because the author has surely not doubted the close relationship between penguins and Procellariiformes and has surely known Simpson's (1946) important conclusions. Yet, in the same system, an attempt is made to group the "Typical birds" according to the vertical principle; that is, not according to their apparent similarity or difference but according to their presumable phylogenetic relationship. For this reason the author follows McDowell (1948) by dropping the former distinction between Palaeognathae and Neognathae.

Max Fürbringer, with his incomparable practical experience, has frankly admitted that the decision in questions of relationship is very often based on rather subjective considerations. Some of the more recent revisors do not display a similarly wise modesty. Verheyen (1958b) makes the proud assertion: "in contradistinction to the conventional classifications we will introduce rational classification," which is based on the totality of as many individual characters as possible. This total sum of characters Verheyen calls the "morphological potential." After equating the morphological potential for a given group of birds with 100, he compares it with the morphological potential of other groups of birds, then calculates the percentage of agreement, and draws from this his phylogenetic conclusions. In this method arithmetic replaces the role of intuition and of a judgment trained in functional interpretation. Elsewhere Verheyen (1955) states: "A clear, precise and phylogenetically sound classification must be based on characters that are practically invariable and which are essentially immune to the adaptation and modification imposed by the habitat." To this I answer: Taxonomy would be indeed a simple matter if such "practically invariable characters" existed. However, the relentless modifying power of evolution does not spare a single structural element; any change of the well integrated morphological total results either at once or gradually in correlated changes from which neither the skeleton, nor the muscles, nor the external features, nor the behavior remain excepted. Let me give one example: the loss of the power of flight causes not only extensive changes of muscles and bones of the anterior limb and of the shoulder girdle, but it also has effects on the pelvis and the posterior limb, and even on the

feathers of the entire body, which become greatly simplified as shown by the struthious birds, by *Apteryx*, by the Dodo, and by some of the flightless rails.

Verheyen is not an isolated example. Other recent students have believed they have found invariable characters that would show them the way through the labyrinth of avian diversity. Lowe relied on the structure of the skull in his studies of the Charadriiformes, but got badly off the track (Bock, 1958). Beecher (1953) based a new classification of the song birds largely on the jaw muscles. His methods and paradoxical conclusions have likewise received well-merited criticism (Mayr, 1955).

The easiest solution was tried by certain authors who compared the accepted system of birds with the system of their parasites, and who in all cases of conflict considered the parasitological evidence as more decisive than the findings of comparative anatomy. This was done by Timmermann (1957). On the basis of their Mallophaga, he concludes that Rostratula does not belong to the Limicolae (Charadrii) but with the rails, *Phaethon* not to the Steganopodes (Pelecaniformes) but with the Laro-Limicolae (Charadriiformes), and so forth. Such an exaggerated evaluation of the parasitological evidence has had the effect that ornithologists will utilize parasitological information only with the greatest caution. In this conclusion I am in entire agreement with Ernst Mayr (1957). For instance, the fact that the flamingos (*Phoenicopterus*) are parasitized by two genera of Mallophaga which otherwise occur only on Anatidae can by no means be considered as proof for an origin of the flamingos from the Anatidae rather than from the Ciconiiformes. It appears by far more probable, that the Mallophaga have been transferred rather recently from the waterfowl to the flamingos. This is not only the view of the ornithologist Mayr (1957), but also of the mallophagan specialist, Dr. von Kéler (1957). May I refer to still another case. Some taxonomists have recently considered it possible that *Struthio* and *Rhea* might form a phylogenetic group because a genus of bird-lice, *Struthiolipeurus*, has been found on both. Von Kéler, however, informs me that close relationship of the mallophagan species found on *Rhea* with that found on *Struthio* has not yet been proved, for their anatomical investigation is still lacking. He is inclined to believe that the superficial similarity between Mallophaga on these birds is due to convergence caused by the similarity of feather structure.

To give you an idea of the kind of "reforms" of our system which have been proposed for anatomical reasons during the past twenty years

(some even earlier), I shall list only a few, making comparison with the classification of Wetmore.

Miss Cottam (1957) has concluded from a detailed study of the skull of *Balaeniceps* that the Whale-headed Stork belongs to the Pelecaniformes and not to the Ciconiiformes. Some 19th century authors suspected, or claimed, relationship between *Sagittarius* and *Cariama*. In the current systems one finds *Sagittarius* with the hawks, *Cariama* with the cranes and their relatives. Verheyen (1957) has again combined these two genera in a special order Cariamiformes, basing his conclusions on their "morphological potential," which includes the relative length of limb bones.

Wetmore places the Screamers (*Palamedea*) as a suborder of the Anseriformes, with which, according to Verheyen (1953), they have nothing to do. Wetmore has *Opisthocomus* in the order Galliformes, *Musophaga* in the order Cuculiformes. Verheyen (1956) on the other hand combines *Opisthocomus* with the Musophagidae in the order Musiphagiformes. Barnikol (1953) considers *Opisthocomus* a very isolated species, which can be placed neither with the Galli nor with the Musophagidae and represents a separate order Opisthocomae.

Wetmore and all previous authors have placed the Dodo, *Raphus*, together with *Pezophaps*, in a highly specialized family of the Columbiformes. Verheyen (1957a), on the contrary, includes both, together with *Goura* and *Caloenas*, in the Caloenadidae, another family of the pigeons. Quite recently Lüttschwager (1958) has contended that *Raphus* and *Pezophaps* do not belong to the pigeons at all, but rather to the rails, or to a special order related to the rails.

Fürbringer's category of Gruiformes, which Wetmore had accepted essentially without change, has been severely attacked by Verheyen (1957b). He removes from the Gruiformes the Sunbittern (*Eurypyga*) and the Kagu (*Rhynochetos*) and combines them with the Jacanidae in the order Jacaniformes. Wetmore placed the Jacanidae in the Charadriiformes, but Lowe (1931) declared the Jacanidae to be Gruiform. *Thinocorys* has been placed by Verheyen (1958a) as a family with the Pterocletes (sandgrouse). The Pterocletes, combined with the buttonquails (Turnices) and the Mesoenatidae, form Verheyen's new order Turniciformes. According to Lowe (1923, 1924), however, *Thinocorys* is "undoubtedly charadriiform," while the Mesoenatidae represent an entirely isolated group of birds with gruiform similarities, and the Turnices, together with the sandgrouse, belong near the pigeons. The swifts (Apodes) are according to Verheyen (1956a) near to the Caprimulgi, while according to Lowe (1939) they are not at all related

to them. These examples indicate how utterly different the taxonomic conclusions of these two authors are.

Even though this is only a small selection from recent proposals, I fear that the readers are already confused. But they need not feel ashamed of their discomfort. In my opinion only few, if any, of these taxonomic variants will survive the struggle for existence. Most of them will be forgotten within a few years, even though they have been to a large part the result of laborious and conscientious investigations. They have however contributed to one important realization. They have made it apparent that the relationship of certain species or groups of species is far less unequivocably established than one would conclude from a study of currently adopted systems, the authors of which attempt to present a simplified phylogenetic tree of birds. This "attempt to reduce the number of the branches of the phylogenetic tree, to make the ornithic tree simpler, more a noble tree with fewer but more generous branches," as Friedmann (1955) has put it, may have didactic advantages, but does not give a realistic representation of the actual pattern of development. Fürbringer's (1888) attempt at phylogenetic tree construction conveys a more realistic view of actuality. It shows a tall trunk which after sending out a few side branches (the ratites or protocarinates), splits up completely into a dense bush of individual branches. These branches either diverge widely from each other, or else remain closely parallel for longer or shorter stretches. The main branches correspond to the 73 families or family groups accepted by Fürbringer. He attempted to combine these into Gentes, Subordines, Ordines and Subclasses, but emphasized that the difficulties and uncertainties grow with each higher category. Let me quote his own words: "At the present time only very little is completely certain, some is highly probable, the majority of the groupings are however probable only to a medium degree."

The degree of uncertainty has decreased remarkably little since the time when the great anatomist wrote these words—in spite of all the efforts of subsequent authors. The currently adopted systems have eliminated with good reason many of Fürbringer's hypothetical groupings, particularly his Subordines and Ordines, and retained only the Gentes of his system, for which they use the name orders. Wetmore has not been entirely consistent in this, because his orders correspond sometimes to Fürbringer's Subordines, sometimes to his Gentes, which leads to unharmonious results. No doubt Wetmore has been guided by didactic considerations—an endeavor to propose a system that would be convenient for teaching purposes. Lowe (1939) seemed to have had the same objective when he was loath to place the Apodes and

the Trochili into two separate orders. This, he said, "is an easy way of getting out of a difficult situation, but it tells us nothing of their affinities. In effect, it merely tells us that the swifts are swifts and the hummingbirds are hummingbirdlike birds." For this reason Lowe decided to redefine the order Passeriformes and include in it as suborders the Passeres, Cypseli, Trochili and Pici. However this is a rather hypothetical grouping, which has not fully pleased anyone. Personally I prefer a system that is as realistic as possible, a system in which no room is given to phylogenetic speculations, and in which the gaps in our knowledge are frankly admitted. If one follows these guiding principles one is forced to recognize a greater number of the highest categories, that is orders, than accepted by Wetmore—indeed even more than I admitted in 1934. Combining swifts and hummingbirds in the order Macrochires and turacos and cuckoos in the order Cuculi, as I had done following Fürbringer, was insufficiently supported by the evidence and has since been heavily attacked. The new attacks against Wetmore's system are particularly directed against those places where the author adopted as an "order" one of Fürbringer's Subordines, that is a category of "medium probability" and gave it the same rank as one of Fürbringer's Gentes, that is a category of "high probability." It seems to me that the critics would have done a more useful job if they had been satisfied to leave isolated, as groups "incertae sedis," those elements from Wetmore's structure which they removed as incongruous. However, like Lowe, they thought that that would "tell us nothing of their affinities," and thus they have inserted these building stones in a different place, where they fit even less.

To strike a more positive note, I should like to mention some successful attempts to improve the avian system. Many authors have recently studied the question of the evolution of the so-called Ratitae. This was done through ontogenetical investigations by Lutz (1942), McDowell (1948), de Beer (1956), and Charlotte Lang (1956) and through comparative studies of the bony palate by Hofer (1945). All agree in considering, as did Fürbringer, the Ratitae to have originated not from flightless Procarinatae but from flying Protocarinatae. However, while Hofer postulates for all Palaeognathae a common origin from a type not unlike the Tinamids, this is not the case according to McDowell. This author considers the palaeognathic palate to have developed from the neognathic palate, and therefore not to represent a group character of any taxonomic value. He thinks that *Rhea* might have descended from the Tinamids and have acquired by neoteny a simplified palate. The close affinity of *Dinornis* to *Apteryx* on the

other hand, and their great phylogenetic distance from the other ostrich-like birds, has recently been confirmed by Starck (1955) and Charlotte Lang (1956), who studied the endocranium. In most other cases the result of successful attempts has been a clarification on the level of the lower categories of the rank of family, subfamily, or genus. Owing to convergent evolution, similarities may develop between unrelated lines which can deceive sytematists into assuming a phylogenetic relationship. Such errors can only be uncovered by thorough anatomical investigation. By this method it has been shown by Stolpe (1935) that the similarity between grebes and loons is due to convergence, a similarity which had been interpreted by Fürbringer as a manifestation of phylogenetic relationship. Amadon (1951) succeeded, through a study of the syrinx, in unmasking the Madagascar genus *Neodrepanis* (in spite of its sunbird-like features) as a relative of *Philepitta*—that is a Mesomyodian passerine. By the same reliable technique it has been shown by Wetmore (1943:306) that the wren-like South American genus *Ramphocaenus* is an Oscinine bird and not a Mesomyodian, as had been believed formerly for zoogeographic reasons. Mayr (1931) showed that the Pitta-like Papuan genus *Melampitta* does not have an oligomyodian but a polymyodian syrinx and that it therefore does not belong to the Pittidae. Syrinx structure is unfortunately of no help in the task of a subdivision of the Oscines with their immensely great number of species which have entered the most diverse ecological niches. In order to separate within this great mass of forms those which are related from those which have become similar through convergence, one must search for combinations of novel clues, including such as revealed by ethological studies. A combination of characters has quite recently been used by Deignan (1958) for clarifying the relationship of the curious genus *Apalopteron* from the Bonin Islands, hitherto regarded as an aberrant Pycnonotid or Timaliid. He found not only that the tongue of *Apalopteron* suited the general type of the Meliphagidae, but also other structures, like the *nares perviae*, and he refers besides to the type of nest, which supports the morphological arguments. Beecher (1951) has, on the basis of the conformation of the jaw muscles, broken up the family Coerebidae and assigned its genera to the Thraupidae and the Parulidae. His conclusions appear to be valid. However, it has become apparent that the taxonomic usefulness of this structural character, utilized by Beecher, is in general rather questionable. In many cases the systematist who wants to place an aberrant species of song bird is essentially forced to rely on intuition and courage. I am amazed at the courage which is apparent in some of the most recent attempts to

classify the Oscines, for I am one of those timid souls in whose vocabulary the word "perhaps" occurs very frequently. My own system contains therefore many monotypic genera and monotypic families of Oscines.

The search for cases in which systematists have so far been deceived by convergence will surely produce further surprising discoveries. We can therefore look forward to much useful activity by those who plan to devote their energy to the field of bird anatomy. I recommend that he confine his comparative studies to representatives of the same order, family, or genus, the close relationship of which facilitates separation of relatively recent *functional* modifications from the more stable and taxonomically more important structures. He will be fascinated by this topic, for every true naturalist has been uplifted by the discovery of interrelations between form and function. In this field he is sure to move on firm ground and does not need to bridge the gaps in our knowledge by flimsy speculations.

Professional zoologists tended in former days to look down at occupation with systematic categories below the level orders. They found a greater challenge to their ingenuity in the search for the major lines of evolution. Within recent decades however there has been a complete revaluation of the scientific significance of the systematics of the lower categories. It is now recognized that it is as important as is a knowledge of histology and cytology for an understanding of the integral structure of the body.

But as far as the problem of the relationship of the orders of birds is concerned, so many distinguished investigators have labored in this field in vain, that little hope is left for spectacular break-throughs. Only lucky discoveries of fossils can help us, but the chances of making such finds are very small. Simpson (1946) has recently pointed out that the evolution of birds has made virtually no progress since early Tertiary times, quite in contrast to the situation among the mammals. The separation of the existing orders of birds from each other had already taken place in the Cretaceous, if not even in the Jurassic. It is therefore not surprising, that no light has been shed on avian phylogeny by the few well preserved fossil remains from the upper Cretaceous. *Hesperornis* as well as *Ichthyornis* were already highly specialized and entirely different from each other, at least as much as are today a penguin and a gull.

The bird life of the Tertiary was richer in different types than the avifauna of today. Many branches of the avian tree died before or during the Pleistocene.

In view of the continuing absence of trustworthy information on the

relationship of the highest categories of birds to each other it becomes strictly a matter of convention how to group them into orders. Science ends where comparative morphology, comparative physiology, comparative ethology have failed us after neary 200 years of efforts. The rest is silence.

APPENDIX

SUGGESTED AVIAN ORDERS

In parentheses are indicated the corresponding taxa and nomenclature of the Wetmore (1951) classification (names ending in -formes representing orders). Colymbiformes of that (1951) classification was changed to Podicipediformes in the A.O.U. Check-list (1957).

Struthiones	(Struthioniformes)
Rheae	(Rheiformes)
Casuarii	(Casuariiformes)
Aepyornithes	(Aepyornithiformes)
Apteryges	(Dinornithiformes + Apterygiformes)
Crypturi	(Tinamiformes)
Galli	(Galliformes)
Opisthocomi	(Suborder of Galliformes)
Turnices	(Suborder of Gruiformes)
Columbae	(Suborder of Columbiformes)
Pterocletes	(Suborder of Columbiformes)
Ralli	(Superfamily Ralloidea of Suborder Grues of Gruiformes)
Heliornithes	(Suborder of Gruiformes)
Mesoenades	(Suborder of Gruiformes)
Jacanae	(Superfamily Jacanoidea of Suborder Charadrii of Charadriiformes)
Thinocori	(Superfamily Thinocoroidea of Suborder Charadrii of Charadriiformes)
Rhynocheti	(Suborder of Gruiformes)
Eurypygae	(Suborder of Gruiformes)
Cariamae	(Suborder of Gruiformes)
Psophiae	(Fam. Psophiidae of Superfamily Gruoidea of Suborder Grues of Gruiformes)
Grues	(Fam. Gruidae + Aramidae of Superfamily Gruoidea of Suborder Grues of Gruiformes)
Otides	(Suborder of Gruiformes)
Laro-Limicolae	(Suborders Charadrii + Lari of Charadriiformes)
Alcae	(Suborder of Charadriiformes)
Gaviae	(Gaviiformes)
Podicipedes	(Colymbiformes, now Podicipediformes)
Sphenisci	(Sphenisciformes)
Tubinares	(Procellariiformes)
Anseres	(Suborder of Anseriformes)
Anhimae	(Suborder of Anseriformes)
Steganopodes	(Pelecaniformes)
Phoenicopteri	(Suborder of Ciconiiformes)
Gressores	(Suborders Ardeae + Balaenicipites + Ciconiae of Ciconiiformes)
Accipitres	(Falconiformes)
Musophagae	(Suborder of Cuculiformes)
Cuculi	(Suborder of Cuculiformes)
Psittaci	(Psittaciformes)
Striges	(Strigiformes)
Caprimulgi	(Caprimulgiformes)
Coraciae	(Families Coraciidae + Leptosomatidae + Brachypteraciidae of Suborder Coracii of Coraciiformes)
Halcyones	(Superfamily Alcedinoidea of Suborder Alcedines of Coraciiformes)
Meropes	(Suborder of Coraciiformes)
Momoti	(Superfamily Momotoidea of Suborder Alcedines of Coraciiformes)

Todi	(Superfamily Todoidea of Suborder Alcedines of Coraciiformes)
Upupae	(Families Upupidae + Phoeniculidae of Suborder Coracii + Suborder Bucerotes of Coraciiformes)
Trogones	(Trogoniformes)
Colii	(Coliiformes)
Apodes	(Suborder of Apodiformes)
Trochili	(Suborder of Apodiformes)
Pici	(Piciformes)
Passeres	(Passeriformes)

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(Above) Nestling Groove-billed Ani about six days old, its feathers just beginning to unsheath. Near Tela, Honduras, August 15, 1930. *(Below)* The same nestling 24 hours later, showing rapid advance in feathering. Near Tela, Honduras, August 16, 1930. (Photos. by A. F. Skutch.)

LIFE HISTORY OF THE GROOVE-BILLED ANI

BY ALEXANDER F. SKUTCH

This paper is a report on observations made on the Groove-billed Ani *(Crotophaga sulcirostris)* in Central America over many years, but chiefly from 1930 to 1940, when I lived in regions where these birds are more abundant than about my present abode in the Valley of El General in Costa Rica. In subsequent years a little additional information was gathered. The species has a wide range from the lower Rio Grande Valley in Texas through Middle America and much of northern South America. Since, as far as I know, no one has ever published a comprehensive study of this common and most interesting bird and available accounts of its breeding habits are only compilations from scattered sources, it will perhaps be of value to students of bird behavior to have all of my observations in a single paper.

Characteristics and Daily Life

Appearance.—Although the anis have much to recommend them to the attention of the naturalist, it is not by their beauty that they attract him. With the exception of the vultures, they are the least comely birds that I know. Yet they are not absolutely ugly, for being birds, they wear feathers and, as Grey of Fallodon once wrote about another not very comely bird, having feathers they cannot avoid a certain degree of beauty. The anis are lean and lank and loosely put together, and their long tails, which are almost invariably frayed and worn, seem so inadequately attached to their bodies that they are in danger of being brushed off as the birds push through the tall grasses and weeds where they forage. In facial expression they are especially unfortunate. The Groove-billed Ani's black bill is narrow and very high, with the upper mandible strongly arched and furrowed lengthwise by parallel curved ridges and channels. Its black face is largely bare of feathers and prominent lashes shade its dark, beady eyes. Its plumage is everywhere black, but the feathers on its neck present a scaled appearance, while greenish and purplish glints play over its body and wings in the sunshine and redeem the black monotony of the bird.

Voice.—In voice the anis are hardly more pleasing than in appearance. Members of the cuckoo family, they are not songbirds and they lack even the stirring calls of some of their relatives. The call-note of the Groove-billed Ani is well paraphrased by one of the common names given to it in Guatemala, *Pijúy* (pronounced *pe-húy*) or *Pichuy*. This disyllable is uttered as the anis perch or fly, usually

thrice together in a soft, high-pitched voice, neither unpleasant nor particularly delightful, and it is usually preceded by a few preliminary throaty clucks which one can hear only when close to the bird, thus: *tuc tuc tuc pihuy pihuy pihuy.* A Costa Rican name for the ani, *Tijo tijo (téeho téeho)* represents another attempt to reproduce its peculiar call in human language. These notes are certainly more attractive than the high-pitched whine of the Smooth-billed Ani *(C. ani)* of the West Indies and South America. Where the ranges of these two black birds overlap, as in western Ecuador, Colombia, Venezuela and Panamá, they can be distinguished by their voices more readily than by their appearance.

Other utterances which I have heard from the Groove-billed Ani include a full, long-continued, mournful call, soft but deep, an expression of anxiety or distress, which one individual delivered while I examined its nest and another after it had been repeatedly repulsed by some Smooth-billed Anis which it tried to join; a harsh, rasping *grrr* voiced as the birds attack intruders at their nests; and a cackling sound which parents used when trying to coax a fallen nestling to return to its nest.

Sociability.—But if the anis lack beautiful plumage and a melodious voice, they have been amply compensated in other ways. They have been endowed by nature with an extraordinarily affectionate disposition, a degree of adaptability which enables them to thrive in a far greater range of environments than most other birds, and nesting habits which make them, in the eyes of the bird-watcher, second in interest to none. Few birds crave the company of their kind more constantly than the anis. I have never seen them engage in a quarrel or fight. When one is separated from its flock it calls and calls until it finds its companions. Even in hot weather, when there is no need to huddle together for warmth, two, three, or more perch side by side as closely as they can press. If one of the inside birds of such a group flies off, the others at once close the gap until they touch each other again. While one stretches up its neck its neighbor carefully bills and nibbles at the feathers, possibly searching for insect pests; and when the first has finished its kind office to the second, the latter reciprocates the favor.

When not nesting, the anis associate in small parties which usually include from ten to twenty individuals. These travel over their home range in a leisurely manner, foraging as they go, or pausing to rest on low perches singly or in little groups. They do not, as some birds, form a close flock which moves as a unit and seems to be motivated by a single will, but they straggle along singly or a few together, often

strung over a distance of a few hundred feet, and keep in contact by their voices. Sometimes one ani starts off on an expedition only to find that its companions do not care to follow, in which case, after calling to them in vain, it turns again in the direction of the main party.

Flight.—The anis' mode of flight is as characteristic as any other of their peculiar habits. A long journey, say anything much in excess of a hundred yards, is seldom made by a continuous flight, but the bird advances with frequent pauses in conveniently situated trees and bushes. As it alights on one of the lower branches, the momentum of its long tail carries it forward above the bird's head with a jerk. Recovering its balance, the ani delays here for some moments, looking around with caution and calling in a high-pitched voice. Then, satisfied that the path ahead is clear, with a *tuc tuc tuc pihuy pihuy pihuy,* it launches itself upon the next stage of its journey. A few rapid beats of its short wings serve to impart the requisite momentum; then it sets them for a long glide, by which it may cover a surprisingly long distance, on a slightly descending course, without further muscular exertion. If its ultimate destination is a certain branch in a tree or bush, it will often arrest its flight on another limb considerably lower. Then, by a few queer, rapid, sideways hops along the bough and some bounds or, better, bounces from limb to limb, it gains the desired position, where, most likely, it spreads its wings to the morning sunshine.

Sun-bathing.—In the cold, wet weather of the rainy season, the anis are a picture of misery as they huddle together on a perch, their heads drawn in among their damp, bedraggled feathers. Although they dislike wetness, they must often seek their food amid water-laden grass and foliage. Then to dry themselves they perch atop a fence post, a stake or a bare limb and patiently hold their wings spread to the rays of the sun, looking very much (if they will forgive the comparison) like miniature vultures. This habit of resting in the sunlight with outstretched wings seems best developed in birds with black or blackish plumage. In Central America the species I have most often seen sunning their wings in this manner are the Turkey Vulture *(Cathartes aura),* the Black Vulture *(Coragyps atratus),* the Anhinga *(Anhinga anhinga)* and the anis. Because not only in plumage but also in this mannerism the ani resembles a vulture, in Costa Rica it is sometimes called *zopilotillo,* the diminutive of *zopilote* (vulture).

Habitat.—The variety of habitats acceptable to the anis is great and their chief restriction seems to be that they do not tolerate the forest. Birds of open country, they seem nearly indifferent to its type. In

the cultivated parts of the humid coastal regions of Central America they are one of the most conspicuous species, although certainly not more numerous than the tiny seedeaters *(Sporophila spp.)*, which are legion but much less noticeable because of their smallness. Their favorite habitats are bushy pastures, orchards, light open woods, lawns with shrubbery, and the cleared areas about the huts of squatters. Marshland is almost as acceptable to them as a well-drained hillside; and I found them numerous in such extensive stands of sawgrass as that surrounding the Toloa Lagoon in Honduras, although it is probable that in these areas they do not venture far from some outstanding hummock or ridge which supports a few low trees or bushes in which they can roost and nest. In the semi-desert regions of the interior, where their associates of the coastal lands, if present at all, are as a rule rare and confined to moist thickets along the rivers, the anis are abundant, living among thorny cacti and acacias as successfully as amid the rankest vegetation of the districts watered by twelve feet of rainfall in the year. In altitude they range upward to about 5000 feet above sea level in Guatemala and 7500 feet in Costa Rica, but they are not nearly so abundant in the highlands as in the lowlands.

Food and foraging.—The food of the anis consists largely of insects, which they obtain both from the ground and amid the foliage of bushes, and to a much smaller extent of berries and other fruits. They vary their diet with an occasional small lizard. Often they hunt grasshoppers and other creatures amid long grass or tall weeds, where they are completely hidden from view except when from time to time they leap a foot or so above the herbage to snatch up an insect which has tried to escape by flight. Whether they run or hop in such dense vegetation it is scarcely possible to learn, but when they forage over bare ground or the short grass of a lawn one can see that they progress by both running and hopping, as best suits the occasion. Sometimes they course swiftly after an insect and finally overtake it by a bound into the air. But their favorite method of foraging is beside a grazing cow, horse or mule. Several together remain close to the head of the quadruped, moving along by awkward hops as it moves and barely keeping out of the way of its jaws and forefeet, ever alert to seize the insects stirred up from the grass by the passage of the herbivore. Rand (1953) presented numerical data to show that the anis catch more insects per minute when foraging with cattle than when hunting alone, and that the quadrupeds are especially helpful to them in the dry season when insects are relatively scarce.

It is frequently stated in books, and affirmed by residents of the

countries where the anis live, that they alight upon cattle and pluck ticks and other vermin from their skin—whence the name *garrapatero* (tick-eater) given to them in parts of Central America. While this is doubtless true to a limited degree in certain parts of the anis' range, I have watched them in the neighborhood of cattle from Panamá to Guatemala and only with extreme rarity have I seen one alight on a cow. Since the ani associates so much with cattle without alighting upon them, and the Giant Cowbird *(Psomocolax oryzivorus)*, another black bird of approximately the same size, does frequently perch on them and relieve them of parasites, it seems likely that the ani may often receive credit for the good offices of the cowbird, especially since the latter is shyer and less known. I have occasionally questioned a man who informed me that the ani plucks ticks from grazing animals, only to find that he was unaware of the existence of the Giant Cowbird. At a slight distance such an unobservant person might easily suppose that the birds upon the animal's back were the same as those of the same color about its feet; and since his nearer approach would leave only the latter, the illusion would probably persist. Rand (1953) failed to see anis perch on cattle in El Salvador, and only once did he see one of these birds pluck a tick from a cow.

Frequently I have come upon a group of anis, sometimes a dozen or more, clustered together in the same spot on the ground or low among bushes, calling excitedly and jumping about in a lively, apparently aimless fashion, as though they had lost their wits. Such animated assemblies generally indicate that they have discovered a battalion of army ants and have flocked to the feast. It is difficult to see just what they do, for often the vegetation is dense, and if one approaches too close they melt away. The anis are canny birds, more or less indifferent to the presence of a man as long as he does not too obviously pay attention to them, but shy and restless whenever they discover that they are being watched. Yet I have little doubt that on these occasions they seek not the ants but the cockroaches, spiders and other small creatures driven from their hiding places in the ground litter by the myrmecine horde. If they preyed upon the ants themselves, so much excitement and apparently aimless jumping around would be inexplicable, for in this case they could stand beside a moving column and pick up multitudes of them without much exertion. The mixed parties of antbirds, Gray-headed Tanagers *(Eucometis penicillata)* and other birds which accompany the army ants in the lowland forests behave in much the same manner, and in their case it is relatively easy to see that they prey not on the ants but on the unfortunate creatures driven from concealment by them. In Vene-

zuela, Beebe (1910) found Smooth-billed Anis following army ants in the same fashion. Thus the adaptable anis avail themselves of creatures as diverse as oxen and ants as hunting dogs to drive up their small prey.

The anis forage among bushes, vine tangles and low trees as well as on the ground. It is amusing to watch them as they jump from branch to branch with a clumsiness of appearance which conceals their real agility. Going either up or down, they progress by a series of short hops from twig to twig and pluck off the invertebrates they discover among the leaves. If an insect attempts to escape by flight, they may dart into the air and snatch it up on the wing. When the first showers that usher in the wet season send the winged brood of the termites forth from their nests in countless multitudes, one may watch the anis everywhere foraging like flycatchers, making ungraceful darts, not exceeding a few feet, from low twigs and fences; but the insects are then so numerous that the birds can catch many without quitting their perches.

Roosting.—Thus, in an unhurried manner, the flock of anis visit each day their favorite hunting grounds, the pasture where they forage at the heads of the cattle, the dooryard where they seek insects amid the shrubbery, more rarely a bush or vine which supplies ripe berries. In the warmest hours of the afternoon they rest in a compact group in the shade. Toward evening they forage more actively again, and before sunset they gather for the night in their roosting tree, by preference an orange tree whose dense, dark green foliage and branches armed with formidable thorns provide both concealment and protection, or a thick clump of spiny bamboos, or these failing, a tangle of vines at the edge of a thicket.

General Observations on Nesting

Breeding season.—Throughout Central America the anis nest late, beginning after the majority of their neighbors of other families have reared one or even two broods. This is because they wait until the dry season has come to an end and returning rains have caused the herbaceous vegetation to grow more lushly, thereby increasing the abundance of grasshoppers and other insects which live in it, and on which the anis depend largely for food. In waiting for the rains to refresh the vegetation before they begin to breed, the Groove-billed Anis resemble the Smooth-billed Anis, which, as Davis (1940) demonstrated, nest sooner in years when the dry season ends early than when it is prolonged. In Central America egg-laying usually begins in June.

The earliest occupied nest of the Groove-billed Ani which has come to my attention in Central America is one which I found on April 26, 1942, on our farm in the valley of El General, Costa Rica, at an altitude of about 2400 feet above sea level. On this date the nest already contained four eggs, which disappeared a few days later. The following year, 1943, a pair of anis began on April 4 to build in an orange tree close by our house, but they left the vicinity before completing their nest. In both 1942 and 1943 much rain fell in March and by April the herbage was already lush. Anis are, inexplicably, by no means so abundant in the valley of El General as in many other agricultural districts of Central America at the same altitude, and they have not again, to my knowledge, attempted to nest on this farm. I have no other records of breeding in El General.

In the Pejivalle Valley on the opposite or Caribbean side of Costa Rica, at an altitude of about 2200 feet, I found on May 31, 1941, a completed nest in which the first egg was laid a day or two later. Bent (1940: 27) quotes from G. K. Cherrie an account of some anis which began to build on May 20 in Costa Rica, probably in the central plateau. But in other parts of Central America, including the humid Caribbean lowlands, one rarely finds evidence of breeding before June. On my first visit to Central America, I spent six months near Almirante in western Panamá and was extremely eager to find nests of the Groove-billed Anis, which were abundant in the vicinity, but I saw none until June 6, the day of my departure, when I was shown a completed nest, still without eggs. The following year, near Tela on the rainy northern coast of Honduras, I found a pair of anis beginning to build on June 4, six weeks after my arrival, and I saw my first nest with eggs on June 23. In 1932, near Los Amates in the humid lower Motagua Valley of Guatemala, I first discovered anis building on June 9, nearly four months after my arrival in this region. On June 26 anis were seen constructing a nest at El Rancho, higher in the same valley, where the rainfall is much less; and on June 29 building was in progress at Cobán, in Alta Verapaz.

In both the humid and arid parts of Central America, July and August are the months when occupied nests are most abundant. At least two broods are reared, and breeding continues into September. My latest nests include: one near Colomba, on the Pacific slope of Guatemala at about 3000 feet, with eggs on September 30, 1934; two at Zacapa in the arid part of the Motagua Valley of Guatemala with eggs on August 13 and 15, respectively, in 1935; and two near Cartago, at 4500 feet in the highlands of Costa Rica, with fresh eggs on August 26 and September 8, respectively, in 1938.

The nest.—The Groove-billed Ani builds by preference in a tree or bush with dense foliage standing in an open space, or at least near the edge of a grass-covered area where it can forage. Its favorite nest site is an orange tree with crowded thorny branches and profuse foliage, or some other kind of *Citrus*. Approximately half of the 29 nests of which I have records were in trees of the orange, lemon, or other varieties of citrus fruits. Thorny plants of other kinds are frequently chosen: one nest was in a dense clump of low, spiny palms,

another in a compact, thorny *Randia;* while in arid regions an organ cactus or an opuntia bristling with needle-like spines is often chosen to support the nest. Where a well-armed, compact tree or shrub is not available, the anis often build in a dense tangle of vines which have overgrown a tree standing in the open or near the edge of a thicket. One nest, in the most impenetrable second-growth, was about 25 feet from the margin of a neighboring grassy plantation and 13 feet above the ground. Sometimes the nest is placed in a clump of bamboo. One pair of anis took possession of the ample, cup-shaped nest which a Boat-tailed Grackle *(Cassidix mexicanus)* had abandoned and refurbished it by adding a few sticks to the rim and lining the bottom with fresh green leaves; but such appropriation of nests of other species is unusual in my experience. In height the nests which I have seen ranged from 4 to 25 feet above the ground, but two-thirds of them were from 5 to 10 feet up. Miller (1932) found a nest only two feet up in El Salvador. As a rule, anis' nests are well concealed by foliage and not easy to find.

The nest is a bulky, usually shallow, bowl-shaped structure, open above. It is constructed of coarse materials, including woody twigs, lengths of dead herbaceous vines, weed stalks, tufts of grass which often have the roots attached to them, strips of palm leaf, rather coarse roots, and the like. The constituents of different nests vary considerably according to what the locality affords. The lining always consists of small leaves, which are placed there while fresh and green and never removed after they wither. The first of these leaves are brought at an early stage of construction and others are added daily until the eggs hatch, so that finally there is a thick layer of dead and dying leaves in the bottom of the nest. It is difficult to give the overall dimensions of such a structure, for one does not know how far along the projecting ends of the constituent twigs, some of which are nearly a yard in length, he should measure. Often the body of the nest is about a foot in diameter. The internal diameter of 6 nests varied from 4¼ by 4½ to 6 by 6½ inches, while in depth these nests ranged from 2¼ to 4¼ inches. The widest nest was also the deepest, but the narrowest was of about average depth, 2¾ inches. Nests more than 3 inches deep are exceptional.

Unfortunately, the unusually ample nest was despoiled before I could learn how many pairs were using it, and I do not know whether if undisturbed it would have provided space for an exceptionally large number of eggs and young. My records are inadequate to show whether structures built and occupied by several pairs are consistently more capacious than those which belong to a single pair.

The nest is built by both sexes of all the co-operating pairs, with

the male usually bringing material which his mate arranges while she sits in the structure, although this division of labor is by no means rigidly adhered to and the female also brings twigs and leaves. Details of nest construction are given in the following sections of this paper.

The time taken to build a nest is most variable. A single pair, whose second-brood nest was despoiled after only two eggs had been laid in it, had three days later a new nest in which the female now began to lay. This latest nest was built on the remains of an earlier structure which this same pair began but failed to finish; however, little of their former work remained when they returned to this site, and practically all the building was done in three days. On the other hand, three or more pairs of anis which started a joint nest in Guatemala about June 9, 1932, were still bringing leaves to it, and had not yet laid, on July 11. Not only do the anis continue to bring green leaves to their nest after incubation has started, at times they even build up the walls with sticks and similar materials.

The eggs.—Whereas tanagers, finches and wood warblers usually lay early in the morning, and many thrushes and flycatchers lay at various hours of the forenoon, anis commonly deposit their eggs around or soon after midday, as I have seen in both the Groove-billed and the Smooth-billed Ani. In the latter species, Davis (1940) also found that eggs are as a rule laid in the early afternoon, although they may be deposited at any time from before 7:00 a. m. to after 5:30 p. m. The interval separating the laying of successive eggs of the Groove-billed Ani is variable, and may range from two to three days even in the same set. Details are given below in the history of the solitary pair.

It is difficult to learn with accuracy the number of eggs laid in an anis' nest. More often than with any other bird that I know, one finds eggs lying on the ground beneath the nest, either whole or broken, and these must be added to those still within the nest to give the full number that were laid. One can never be sure that he has recovered all the eggs that somehow fell from the nest in the course of laying. I do not know just how these eggs get removed from the nest, for I have never been present when this happened. Most anis' nests are so well built that even if a dozen eggs were laid in them they would not roll out of themselves. Possibly the birds carelessly knock them out, but it is also possible that this is done by some predator that is attracted by the appearance of the eggs but after sampling one finds them unpalatable.

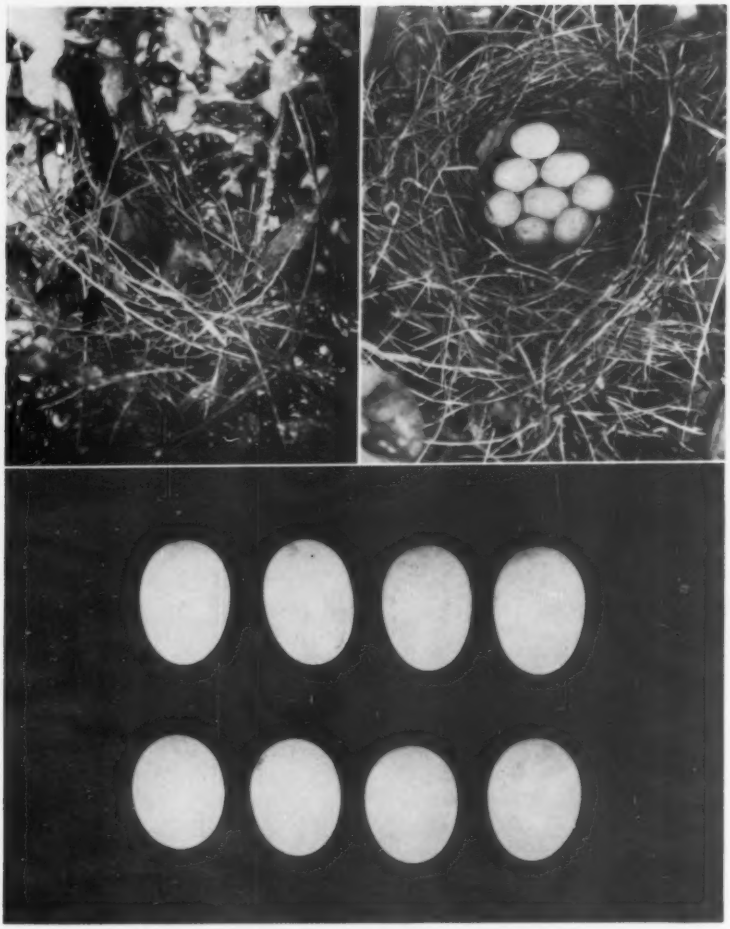
The number of eggs in apparently completed sets that I have seen has ranged from 3 to 12, but one set of 15 was reported to me by a reliable observer. I have found in print no mention of a larger set.

Thus the Groove-billed Ani does not produce such big nestfuls as the Smooth-billed Ani, in which several females may lay as many as 29 eggs in a nest (Davis, 1940). Nests of the Groove-billed Anis attended by a single pair contained from 3 to 5 eggs, but usually a single female produces a set of 4. In one instance a nest with 8 eggs was attended by 4 adults, and another set of 8 eggs was cared for by at least 3 anis. In all, I have watched (rather than merely found) 5 nests in which 2 pairs took an interest; but in the other 3 nests laying had not been finished, or some of the eggs or nestlings had apparently been lost. I once watched at least 6 anis, or 3 pairs, building the same nest, and that which contained 12 eggs seemed to be the property of 3 pairs. The apparently complete sets which appear in my original records were of the following composition (including in 2 instances an egg found beneath the nest): 1 set of 3; 7 sets of 4; 1 set of 5; 3 sets of 8; 1 set of 11; 1 set of 12; 1 set of 15. According to Davis, the female Smooth-billed Ani in Cuba lays between 4 to 7 eggs, and this agrees with my more limited experience with this species in Panamá.

The eggs of the Groove-billed Ani are bluntly ovate in shape. When newly laid they are uniformly covered with a chalky white deposit, which is readily scratched off with a fingernail and in the nest is removed by the birds' bills or toenails, or by rubbing against projecting sticks. The removal of this superficial deposit reveals the blue or blue-green color of the underlying shell, which is equally evident on the inner surface. Not only is the chalky outer layer readily scratched away, it is easily stained by the dying or dead leaves on which the eggs rest, so that by the combined action of scratching and staining the shells soon lose their original whiteness and are far less conspicuous on their bed of green leaves. One can estimate how long they have been in the nest by the degree of their discoloration. The measurements of 56 eggs which I temporarily removed from the nest average 32.1 by 24.2 millimeters. Those showing the 4 extremes measured *35.7* by 25.0, 31.8 by *25.4*, and *28.6* by *22.2* millimeters.

Egg dates.—In 19 nests in the Caribbean lowlands of northern Central America (Tela and lower Ulua Valley in Honduras, Motagua Valley from Los Amates to El Rancho in Guatemala) eggs were laid as follows: late June, 3; July, 11; August, 4; early September, 1.

Details of building, incubation, hatching, care and development of the young, etc., are given in the two following sections and summarized at the end of this paper.



(Above, left) Male Groove-billed Ani, "Whiteface," incubating eggs. Near Tela, Honduras, July 5, 1930. *(Above, right)* Nest of Groove-billed Ani containing eight eggs, apparently laid by two females. Ulua Valley, Honduras, August 5, 1930. *(Below)* Eggs of Groove-billed Ani from a single nest, showing their great variation in size and shape. Those in the upper row were apparently laid by one female and those in the lower row by another. Ulua Valley, Honduras, August 5, 1930. (Photos. by A. F. Skutch.)

HISTORY OF A SOLITARY PAIR

The First Brood

The nest and eggs.—Although several pairs of Groove-billed Anis often lay in the same nest, I hold it fortunate that the first nesting I watched was of a single pair, for thus I was able to discover certain essential points which it is not so easy to learn in the more complex associations of several pairs breeding together. On June 21, 1930, a student at the Lancetilla Experiment Station in Honduras found this nest while spraying a small orange tree, amid whose dense foliage it was well concealed, at a height of seven feet above the ground. When he showed it to me two days later there were two eggs, which had not been present when he first saw the nest. These rested on the bed of fresh green leaves which lined the shallow, rather bulky cup of coarse sticks. I pulled out one of the longest and found it to be 34 inches in length. Although I often saw an ani on the two eggs by day, they were still left uncovered at night. On June 27, four days after the second egg was present, the third and last egg was laid. Even after the set was complete, these erratic birds left the eggs uncovered during the night. Perhaps they awaited a fourth egg, since that is the usual number, but if so they waited in vain. By day they incubated and brought fresh green leaves to the nest. Finally, in the evening of June 29, the third after the last egg had been laid, a bird remained on the nest.

Marking the birds.—The male and female were so similar in appearance and voice that in order to learn their respective parts in incubation I found it desirable to place a distinguishing mark on one of them. By setting into the hollow of the nest a brush soaked with white paint, I was able to mark one member of the pair on its head. I named this bird "Whiteface" and its mate, by way of contrast, "Blackface." Whiteface always sat on the nest at night. Subsequent observation in connection with egg laying established that Whiteface was the male (see p. 299 *infra;* Plate 11, *Above, left*).

Incubation.—These two anis were paragons of conjugal affection. It was pleasant to see, on the morning when I first set up my blind before their nest, how the one who had been frightened from the eggs by my operations flew straight to its mate, who was perched on an exposed branch drying its wings. The two sat as close together as they could press and each billed the other's plumage. They showed their attachment in a dozen little ways. They were constantly calling to each other, even as they entered and left the nest; and sometimes one while sitting answered the call of its mate in the distance. Both

took turns on the nest, but they were at first most impatient sitters, constantly replacing each other. In seven hours of watching during the first six days after the completion of the set, 30 minutes was the longest session that I witnessed. Sometimes one of them sat for only a minute or so before the other flew up to relieve it; and sometimes at the call of its mate the sitting bird would leave the nest unattended to go and perch or feed with its partner. Often they flew up together to the nest, which had been left unguarded for from a few minutes to nearly half an hour while they enjoyed each other's company. One took its place on the eggs while the other, after lingering a moment beside it, went off again. From 7:10 to 10:32 a. m. on July 2, Whiteface incubated for 4 periods ranging from 2 to 19 and totalling 50 minutes, Blackface for 5 periods ranging from less than 1 to 22 minutes and totalling 69 minutes, while the eggs were left alone for 7 periods ranging from 2 to 27 and totalling 83 minutes.

Many times every day, when they came to take their turns at warming the eggs, they brought to their nest fresh leaves which they plucked from a neighboring tree or bush. They tucked these beneath the eggs, and since they never took the trouble to remove the old ones as they withered, by the time the eggs hatched there was a thick layer of dead leaves on the inside of the cup. Usually each bird itself placed the leaf it brought, but sometimes it gave it to the sitting mate, who arranged it in the nest. The eggs were never covered by the leaves but always lay above them. Even when a parent went off spontaneously and left the nest unattended, it made no attempt to conceal or protect the eggs beneath the leaves. From time to time the anis also brought sticks and straws, and while incubating they sometimes arranged the materials of the nest.

As the days slipped by, Whiteface and Blackface shared the common experience of newly-mated couples and became less eager for each other's company. The one who was free stayed at a greater distance from the nest, and they called back and forth less frequently. At first each were rarely out of the other's sight; before their eggs hatched they had settled down into a humdrum routine. While at the beginning of incubation they sat on the eggs for from one to 30 minutes at a time by day and often left them uncovered, by the last two days of incubation their sessions had lengthened greatly and were now seldom less than half an hour. As soon as one partner saw that the other had left the eggs, it went at once to cover them, often plucking a green leaf on the way. In over 5 hours of watching on July 9 and 10, Whiteface took 3 sessions lasting 51, 26 and 53 minutes and totalling 130 minutes, Blackface took 4 sessions lasting 30, 46, 36 and 59 minutes

and totalling 171 minutes, and the nest was unattended for only 2 periods, each of about a minute's duration. Like the Lesser or Rufous-rumped Ground-Cuckoo *(Morococcyx erythropygius)*, the anis continued to bring an occasional stick to their nest to the end of incubation.

A chick's emergence from the shell.—One of the three eggs vanished soon after it was laid. Fourteen days after the deposition of the last egg, I held one of them in my hand while the chick worked its way out. When I first took it up there was a gap in the thicker end which extended about a third of the way around the circumference. The little bird's short, thick bill was in this gap, and so pressed out of position that the lower mandible extended beyond the upper one—a temporary condition. At intervals the struggling prisoner drew its bill farther into the egg, then suddenly pushed it outward, bringing the keeled upper edge, armed with a rather insignificant egg-tooth, against the edge of the shell at one end of the hole, and breaking off a small fragment on the outward thrust. In its squirmings the chick, propelling itself I know not how, rotated imperceptibly slowly in the shell, in such a way that its head, turned under one wing, moved backward and the upper edge of the bill was constantly brought to bear against a fresh portion of the shell, which was chipped off at the next outward thrust. Occasionally the struggling birdling emitted a weak cry. Thus bit by bit the ragged-margined aperture was lengthened until it extended about two-thirds of the way around the circumference of the egg, when the struggles of the bird succeeded in cracking the remainder, and the large end of the shell fell off as a cap. Then the naked creature wormed its way out into my palm, where it lay exhausted by its sustained effort.

The nestlings and their departure.—The two nestlings were blind, black-skinned and without any trace of feathers. In this respect they differed from the Yellow-billed and Black-billed Cuckoos *(Coccyzus americanus* and *C. erythropthalmus)* of North America, which at birth bear a rudimentary down in the form of long, stiff bristles. The parents at once began to show more solicitude for the nestlings than they had ever done for their eggs, and both together flew very close to me, calling *pihuy pihuy*.

At first the nestlings were brooded almost continuously. Usually each parent remained covering them until the other arrived with food, when it left to make way for its mate, who stood on the rim of the nest to place an insect in the widely opened mouth of a youngster. Then, often after delaying several minutes on the rim, it settled down to brood until its partner returned. Rarely the nest was left un-

covered for short periods. The nestlings' eyes opened within two days after they hatched, and their pinfeathers sprouted rapidly. The parents cleaned the nest by swallowing their droppings.

On the morning when the nestlings were six days old I found both of them bristling with long pinfeathers. The true feathers of one of them, apparently that which was the older by a few hours, were already escaping from the ends of the sheaths. The parents were bolder than ever before; while I was at the nest they circled around me and alighted in the small nest tree only a few feet away, calling loudly. As they made darts which brought them close to my head they uttered a harsh, threatening *grrr* and at times snapped their strong bills with a loud *clack*. Whiteface far outstripped his mate in these demonstrations, venturing much closer to me and voicing louder complaints.

Later that same day the older nestling jumped from the nest as I approached, and climbing quickly down through the thorny branches, it finally dropped to the ground. It hopped out of the circle of bare earth which surrounded the tree and pushed through the tall grass beyond until it vanished completely. I searched until, fearing that I might step upon the youngster unseen amid the herbage, I abandoned the fruitless quest. The other nestling had so far clung to the nest; but when I returned to see whether it had remained at home while I was searching for the truant, it, too, climbed out and hopped along a branch, but it stopped short after going about a foot. All the while the parents displayed the greatest excitement.

Leaving the youngsters where they had betaken themselves, I disappeared into my blind to await further developments.

In Panamá I had seen featherless nestlings of the Smooth-billed Ani climb from their nest and crawl through the grass in the same manner. I had read of Hoatzins *(Opisthocomus hoazin)*, queer, primitive birds which live in thickets bordering the lowland rivers and tidal estuaries of South America. Their fuzzy, flightless nestlings, when alarmed, precipitate themselves into the water beneath their nests, and when everything is quiet climb back to them, employing bill and feet and hooked appendages on their wings to raise themselves from twig to twig (Beebe *et al.*, 1917). Herrick (1910) states that young Black-billed Cuckoos climb from the nest at about the same age and stage of development as the anis. But nearly all other altricial nestlings, especially those reared in trees, cling tightly to their nest in the face of danger until their feathers have expanded and they can fly or at least flutter away. It is not that these nestlings are immune to alarm until they have well-developed plumage, but until they can use their wings a threat only makes them cling more tightly to their nest.

Meanwhile Whiteface and Blackface were becoming more composed. They flew about, constantly calling, and looked through the branches of the orange tree and the grass beneath it for the lost

nestling, which remained quietly in hiding. After ten minutes Blackface sat upon the empty nest while the other nestling perched in plain sight before her, but soon she left again to resume her searching and calling. Some minutes later the younger nestling moved back to the edge of the nest. Blackface soon returned and pecked at the leaves which lined the bottom, as though she expected to find her lost youngster hidden beneath them, but not succeeding in this quest, she abandoned it and moved over to brood the other, not in the nest but beside it. Later Blackface came back for another search among the leaves that lined the nest, now all brown and dry, for no new ones had been brought for a week. Then she flew off and found a small insect which she brought to the nestling in the tree. After about an hour this youngster finally entered the nest and was fed and brooded by both parents in the regular manner.

By this time the parents had become calm again. The truant nestling, after an hour and a half of quiet secrecy amid the sheltering grass, now at last emerged into the edge of the bare circle at the base of the orange tree and began to cry in a weak, infantine voice. Blackface, who at this time was brooding the other nestling seven feet above, seemed not to notice its cries; but Whiteface on returning discovered it at once and gave excited calls which immediately brought his mate from the nest. Both flew around and above the youngster, calling and making low, cackling sounds, evidently trying to coax it up into the tree. Yet they were powerless to help it, and Whiteface soon returned to brood the other nestling. For almost an hour the young ani on the ground moved about in the grass, climbing up the stalks and stretching up as far as it could toward the low branches of the tree, from which its parents looked down as though to encourage it. At intervals it peeped softly. Finally it moved over to the trunk and attempted to climb up. But the bare, smooth column, which rose a foot to the lowest branch, proved too much for its slight scansorial powers; and it repeatedly slipped back from the flaring base. After ten minutes of fruitless effort it returned to the grass, where the lowest limbs were tantalizingly close above it.

Although the parents continued to be much concerned about the youngster on the ground, the stay-at-home received most of their attention. The latter was brooded, and fed seven times in two and three-quarters hours, while I saw the former receive only a single morsel. It is possible that it was given a few more meals, for sometimes when its parents approached it was so low in the grass that I could not see just what happened. At least they were far more attentive to their fallen offspring than the Robin *(Erithacus rubecula)*

who, as Hudson (1903) relates, let her own nestling starve slowly before her eyes while she continued to brood the young Cuckoo which had thrown it from the nest. At length, tired of being left alone and more or less neglected, the young ani climbed as far as it could up a grass stalk, beat its wings and launched itself into the air. Needless to say, it promptly fell to the ground; but its attempt to fly was not as ludicrous as it seemed to me at the time. I had not examined the young ani since the morning and remembered it as a nestling that bristled with long feather-sheaths, from which the feathers had just begun to protrude. When finally, convinced that it would not regain the nest without my help, I went to pick it up, I hardly recognized it as the same individual. The feathers had escaped their sheaths with amazing rapidity and it was already well clothed. Its back and under parts, save for a naked line along the middle of the latter, bore soft, downy, black plumage. The flight feathers of both tail and wings now had broad expanded tips, the most advanced of which were from one-half to three-quarters inch in length; so that when the youngster beat the air its wings did indeed exert a lifting power, albeit insufficient for its needs. As I returned it to the nest, Whiteface struck me twice on the back, but not hard enough to cause pain. But the restless youngster would not stay at home, and this time it began to ascend among the branches. I left it to follow its fancies, and later it returned to the nest of its own accord. At dusk I found Whiteface quietly brooding his two restless youngsters.

Next morning both young anis, now well feathered, climbed out of the nest as soon as they saw me approach. Instead of dropping to the ground as one had done on the preceding day—which, as I learned later, is by no means their usual procedure—the week-old anis turned their courses upward and went hopping vigorously from twig to twig, sometimes hooking the bill over a branch to catch themselves when they came a trifle short in a leap. The stronger nestling gained at least three feet above the nest and jumped when I tried to capture it. It went hurtling down through the thorny boughs, in imminent danger of impaling itself on those cruelly sharp spines, until finally it caught hold of one of the lower branches. When I took it in hand it protested with sharp, rasping sounds that resembled the parents' calls of anger. I set it down in the path, where it hopped along at a good pace and finally gained the long grass, in which it tried to conceal itself. After recapturing it, I offered it an outstretched finger as a perch. For a minute it seemed to forget where it was and spread its newly feathered wings with its back toward the morning sun, a miniature of the adults. But soon it remembered me again and, jumping

down, attempted once more to escape. As I returned it to the nest one of the parents—Whiteface, I believe—gave me a good bump on the back of my head. After I left, both youngsters settled down in the nest and were brooded as though they had never been beyond its rim.

Whiteface brooded them for the last time that night, when they were between seven and eight days old. The following two nights they remained in the nest tree but did not return to the nest to sleep. They could not yet fly and had entered a half-scansorial, half-terrestrial stage of their development. When they were ten days old I tried to catch them for a photograph, but they hopped from limb to limb with such agility that, protected as they were by the sharp thorns, I was unable to capture them. Finally I went for a ladder to try to reach them in the top of the tree; but while I was away the parents, who had been interested spectators of the chase, spirited them off to a smaller orange tree about fifty feet distant. Since they were still incapable of sustained flight, they must have crept through the tall grass, which they could do very well, and hopped up to the low branches of the tree. They were now so adept at concealing themselves at the roots of the grasses and at clambering into the densest foliage of bushes that it was extremely difficult to find them.

At the age of 11 days the young anis could make short flights from branch to branch of the same bush or tree. Their bills were smooth, without grooves, and their cheeks were bare of feathers.

The Second Brood

Nest building.—On August 11, three weeks after their nestlings left the orange tree in which they were hatched, Whiteface and his partner began a second nest in a small lime tree 25 feet distant from the site of their first nesting. Of the identity of Whiteface I have no doubt, for his distinguishing marks were still prominent. The faint white stain on his mate's breast, if she was in fact the same individual, had disappeared; but in the absence of contrary evidence I may be permitted to call her Blackface. The two had been too strongly attached to be easily separated. From my blind I watched them building, but they worked in a desultory, half-hearted fashion. Whiteface brought most of the material, consisting of green leaves and sticks in about equal numbers, to Blackface, who sat in the nest to receive and arrange them. Whiteface sometimes undertook this work, too, and occasionally the two were on the nest together for brief periods. The leaves which they brought could not possibly have been intended for the lining of the nest, for it was still no more than a frail platform which

had not yet begun to acquire the form of a bowl. Thus the nest was becoming a pile of mixed sticks and leaves. Doing things in a definite, stereotyped sequence is not the way of the Groove-billed Anis. They line their nest before it is built, then often continue to build it after it has been lined and the eggs have been laid. While with many kinds of birds each stage in the complex series of reproductive activities leads to another and its characteristic activities seem then to be forgotten, the anis sometimes anticipate stages which should come later, or revert to activities which belong to an earlier phase.

After the third day, I no longer saw the pair at this nest and found no more fresh leaves in it. They seemed to have wholly abandoned their half-finished structure, probably because they discovered that it was in a position more than ordinarily exposed. A few days later I discovered Whiteface carrying a green leaf to the old nest in which the first brood had been reared. Later he and his mate brought more leaves, which they laid over the old ones on the inside of the nest, and sticks, which they employed to build up the rim. Many of the latter were taken from the unfinished nest in the neighboring tree, which fast dwindled away.

Egg-laying and identification of the sexes.—They devoted four days to putting the old nest in order, then the first egg was laid in it. For two months I had been calling Whiteface the female because "she" warmed the eggs by night; but when I saw that in building the nest Blackface sat in it to arrange the material which the other brought, I began to doubt the correctness of this view, and I resolved to determine their sexes beyond all doubt by observing which laid the eggs. Early the following morning, I entered my blind to watch for the appearance of the next egg. Both birds sat on the single egg for intervals not exceeding fifteen minutes. They brought a few sticks and leaves to the nest, but neither laid another egg. The second day passed like the first. On the third day I resumed my vigil in the early morning, feeling certain that at last I should witness the laying of the egg. Both Whiteface and Blackface sat in the nest, but the latter more than the former. In the middle of the morning, while Blackface sat, Whiteface worked harder than I had ever before seen either partner work. In 21 minutes he brought 13 sticks, some of which were transferred from the remnant of the unfinished nest in the lime tree, while others were picked up from the ground beneath the nest now in use. Many of these sticks were much longer than the bird and he had much trouble in pulling them up through the close-set, spiny branches of the orange tree. All were given to Blackface, who arranged them on the nest.

When I left the blind at 11:10 a. m. there was still a single egg. I returned from lunch at 12:30 p. m. and was chagrined to find that the anis had stolen a march on me and laid the second egg in my absence. I had spent the better part of two and a half days, in the main very monotonous because the anis were out of sight, sitting on a hard box in a stuffy blind, and in the end I had missed the event I had waited so long to see. But at least I now knew in what part of the day it occurred, and with this knowledge it should be relatively easy to observe the laying of the third egg. The chief difficulty was that the interval between the deposition of successive eggs was irregular, and it appeared to vary from one or two to four days.

On returning to the nest the following morning, I found one member of the pair sitting in it, but the eggs had vanished and only some fragments of shell lay on the ground beneath. I began to despair of ever solving the question of Whiteface's sex; but the birds were not so easily discouraged and turned their attention again to the dismantled second nest, of which only a few sticks remained in the crotch of the lime tree. The very next day they resumed work on it, bringing more sticks and leaves. I noticed this time that the sticks were not always picked up from the ground. I saw the anis break with their bills long, slender, dead twigs from the eucalyptus trees that grew close by. Such was their industry that three days after their eggs had been destroyed the new nest was ready to receive its first egg, which was laid between 12:45 p. m. and sunset on August 29.

At a few minutes before twelve o'clock on September 1, I entered my blind before the new nest, which still contained its single egg. Just before noon Blackface flew up with empty bill, calling, and entered the nest. While she sat Whiteface brought sticks and green leaves which she arranged in the nest. After 18 minutes Blackface left the nest and I hurried up to look in. A second spotless white egg lay beside the first on the bed of dark green leaves. So Blackface was the female, and Whiteface, the bird who incubated every night, who was the bolder in defending the young, and brought sticks and leaves to the nest while the other sat in it—Whiteface to whom for nearly three months I had applied the feminine pronoun—was the male!

I might at any time after the first nesting have settled this point by shooting either member of the pair and performing a dissection—a matter of ten minutes instead of the several days it cost me. But there were many considerations which weighed against the latter course, the first and most irrefutable of which was that of sentiment. A large share of the joy which this discovery brought to me arose from the circumstance that I had accomplished it without the sacrifice

of life, after having worked out an appropriate procedure. Moreover, if in this instance I had chosen the easier way of learning Whiteface's sex, I should have missed some of the most exciting revelations which this family made to me.

Three days had elapsed between the laying of the first and second eggs at this nest, but only two intervened between the deposition of the second and the third, and two more between the third and the fourth. The fact that Blackface had laid six eggs in practically unbroken succession (only four days had elapsed between the deposition of the second egg in the rehabilitated old nest and of the first in the new nest) when the normal set consists of only four eggs, is but one more example of a bird's marvellous power to control an intricate physiological process in response to unforeseen external events.

Again Whiteface assumed responsibility for the eggs during the night. I believe that he might have sat through the night before the last egg was laid, but when I approached close enough to see whether he was on the nest, he flew off through the twilight to join his mate in the bamboo grove where she roosted. Birds so sociable and affectionate as the anis must feel keenly the loneliness of passing the night on the nest far away from their companions, who sleep in some dense vegetation at a distance; and at the outset of incubation any excuse to desert their eggs and fly to their comrades, while there is still enough light to find them, is taken as a good one. The following evening, too, Whiteface flew from the nest as I was entering the blind and would not return, although it was still quite light. But later, when he had become more attached to the nest, he would return even if driven off in the dusk, provided that I retired to a reasonable distance, or slipped into the blind, before it was quite dark. I subjected him to these annoyances because I wished to make certain that it was always he who covered the eggs by night.

Years later, in Panamá, I studied a nest of the Smooth-billed Ani attended by three adults, which I had marked with paint by the method I used in the case of Whiteface. One day two of these birds each laid an egg between 12:30 and 1:53 p. m. Since these females laid fertile eggs, the third member of the group was evidently a male. He, too, occupied the nest by night, while his partners roosted in some bushes on the neighboring shore of Gatún Lake. Anis resemble pigeons and doves in that the male brings building materials to the female while she sits on the nest arranging them, in the occasional reversal of the roles of the two sexes in nest construction, and in their occasional spurts of concentrated building while incubation is in progress. But in pigeons it is always the female who takes charge of the nest through the night.

A juvenile helper.—The home life of the Groove-billed Anis is beautified by the affection which persists between all the members of

the family. One of the two youngsters of Blackface's first brood was the constant companion of his parents while they were busy with their second brood. There could be little doubt as to his identity, for although he was nearly as large as the parents, his bill, except for the faint beginnings of grooves at the base, was smooth. I do not know what fate befell the other youngster. The surviving one frequently rested on the nest's rim while a parent warmed the eggs. Once, while Blackface sat, I saw him fly to the nest with a roach in his bill. I thought that I was about to behold something wholly unprecedented in my experience with birds, a youngster feeding its parents. Doubtless if it were the habit of the female ani, as of the female of the Brown Jay *(Psilorhinus mexicanus)* and many other birds, to be fed by her mate while she incubates, she would have accepted the roach from her offspring, for he held it in his bill a full minute before he swallowed it himself. Later, while Whiteface was in the nest, the young ani arrived with a small lizard. He held it within reach of his father, possibly offering it to him, but the latter was not interested in it. The youngster carried it away only to bring it back a minute later. Still Whiteface showed no desire for the lizard, and the young ani finally ate it himself. I never saw a breeding ani go to the nest with food in its bill while its mate incubated. Sometimes Whiteface and the youngster perched side by side nibbling each other's feathers in the fashion of the adults. When I approached the nest, the young bird flew around me with his parents, sharing their excitement and adding to theirs his shrill calls of protest.

On September 18, three of the four eggs hatched. The one which was deposited last hatched 13 days after it was laid; if it had been warmed during its first night in the nest, it might have hatched in 12 days. Davis (1940) found the incubation period of the Smooth-billed Ani to be about 13 days, although sometimes it was as long as 15 days. The eggs of the parasitic Cuckoo of Europe hatch in 12 or 13 days.

From what I had seen of the young ani's actions while his parents incubated their second set of eggs, I was hardly surprised when I first saw him, at the age of 72 days, give a small lizard to one of his younger brothers and sisters—on the contrary, for some weeks I had been eagerly waiting to see this happen. Yet this occurred long before I saw a Brown Jay's nest, and such precocious participation in parental offices was wholly new to me. The youngster fed the nestlings regularly, although not as often as the parents. In four and a quarter hours, Whiteface, always the more attentive parent, brought food to the three nestlings 29 times, Blackface 14, and their young assistant 8.

The young bird not only fed the nestlings but was zealous in protecting them, flying up close to me and uttering an angry *grrr-rr-rr* whenever I went near them. In the absence of the parents he attempted to defend them alone. He was already a more spirited guardian of the nest than Blackface, and from this early ardor I surmised that he was a male; for his father had shown himself to be so much bolder than his mother when their family seemed to be in danger. In the Smooth-billed Ani, too, juveniles of the first brood sometimes feed nestlings of the second brood, and Davis saw one youngster do this when only 48 days old. A hand-reared youngster of this species engaged in building activities when about six weeks old (Merritt, 1951).

Of the further history of Whiteface's family there is little to record. When the three nestlings were nine days old and covered with feathers, they left the tree in which they were hatched. The identifying marks gradually faded from the parents, and if I saw them again I could not distinguish them from others of their kind.

OBSERVATIONS ON JOINT NESTS

Social relations prior to nesting.—Through the early months of the year, from February to May, when neighboring birds of other species are mating and building their nests, the Groove-billed Anis live together in small flocks and give no indication of being paired. Two often perch in contact, each in turn billing the other's neck; but even more frequently one sees three birds sitting in a compact row, and these little coteries seem not to be founded on the attraction of opposite sexes. In May and early June, however, the anis pair off and are then seen two by two instead of in the larger groups which prevailed earlier in the year. The mated birds are inseparable, foraging together, perching side by side, preening each other's feathers, and calling persistently to each other if they happen to become separated. They give every indication of being monogamous, and one rarely sees mates more attached.

Construction of joint nests.—In June, 1932, I watched the construction of a joint nest in a small orange tree behind the plantation house at "Alsacia" in the Motagua Valley of Guatemala. From the first, three pairs certainly participated in building this nest, and possibly there were five pairs, for I sometimes saw this number in the vicinity. But I could not distinguish all these birds individually, and they never all remained in sight long enough for me to be sure that the five pairs worked at the nest. Yet whether there were three pairs or five their conduct was fundamentally the same, for they worked in

pairs and never all together. The mated male and female flew up to the nest tree together, sometimes with one in advance, sometimes side by side, calling *pihuy pihuy pihuy*. One bird took its place on the little pile of dry weed stems and leaves in a crotch of the tree which was the beginning of the nest, while the other perched close by, or at times actually sat beside its mate on the incipient structure. They often tarried quietly in either of these positions for many minutes, doing no work; but at other times the partner on the nest arranged the materials with her bill, or shaped it with her body. More rarely, when they approached the nest one bore a stick or a green leaf in his bill. After his mate had settled on the nest, he gave it to her to be worked into the growing structure. I use these pronouns advisedly, because, in the case of the solitary pair that I had previously watched, it was usually Whiteface, the male, who brought the materials to his mate as she sat on the nest.

While one ani remained on the nest, the other brought sticks and green leaves to her. The sticks were often found in the nest tree, where they had been dropped among the close-set branches on some earlier occasion; but many were picked up from the ground, or broken with the bill from a bush in the neighboring pasture. The dead, much-branched inflorescence of a shrubby composite was frequently pulled off to be used in the nest. However acquired, the material was taken to the partner on the nest and she put it into place. The green leaves were usually plucked from the nest tree and mixed at random with the sticks, even when the nest was in its earliest stages, although they could be of no particular use until the cup of sticks had been completed and was ready for its lining. The males disliked to add sticks to the nest in the absence of their mates. Once, when a supposed female happened to leave the nest just as her partner approached with a stick in his bill, he followed her still carrying his burden and dropped it at a distance. At another time, I saw an ani break a dead flower stalk from the composite bush in the pasture, fly up with it to his mate perching in the hedgerow, then proceed to the nest, evidently expecting her to follow. When he reached the orange tree he found that she had not budged, so he took the stalk back to her, then returned again to the nest, calling to her as he went. Finding that she was still not inclined to come, he placed his burden on the nest and rejoined her in the hedgerow.

Groove-billed Anis seem almost incapable of quarreling among themselves. The three or more pairs worked together in the greatest harmony. There was not the least display of jealousy among them, and two or more pairs often perched quietly in the same bush. Each

pair preferred to work alone at the nest; and if a second pair flew into the nest tree, the first often quietly withdrew. But this was not always their behavior, and sometimes one member of the second pair (probably the female) settled on the nest beside one of the first pair, while their two mates perched near by, or else brought them sticks. Rarely three pairs were in the nest tree simultaneously. Once three birds tried to sit on the unfinished nest together; but these, I believe, were the male and female of one pair and the female of a second pair. Whiteface and his mate, working alone and in a hurry, had built a serviceable nest in three days; but these three pairs, beginning early and proceeding at their leisure, were about three weeks in building theirs. At the end of a month, when I was obliged to leave them, there were still no eggs, although the birds continued to take an interest in the nest and to bring fresh leaves to the lining.

In Chiapas, México, Alvarez del Toro (1948) watched nest construction by a group of Groove-billed Anis consisting of one male and two females, but he did not state whether this deviation from monogamy was caused by the isolation of these three birds, which made it impossible for each of the females to find a separate mate. This was the case with the three Smooth-billed Anis which in Panamá nested in a small clearing separated by wide expanses of forest and water from others of their kind. Here the polygynous relationship appeared to be an adjustment to the disparity of the sexes in the small, isolated group. According to Davis (1940), in Cuba this species exhibits monogamy, polygyny and polyandry all in the same neighborhood.

Egg laying.—One of the joint nests of the Groove-billed Ani most satisfactory to watch of all that I found was situated in a small orange tree at Birichichi, beside the Río Ulua in Honduras. It was constructed largely of tufts of grass, straws and stems of herbaceous plants, many of them with the roots attached, suggesting that they had been pulled from the earth by the birds. Few woody sticks were included in it because the nest tree stood in a field where few were to be found, and the ani, being an adaptable bird, manages to use what is closest at hand. Since this nest was too far away for me to visit it daily, the man who showed it to me kindly made a record of the dates on which the eggs were laid, which of itself, when it is recalled that a female ani usually deposits her eggs at intervals of two days or more, shows that at least two individuals produced them:

July 22—1 egg	July 26—5 eggs
July 23—2 eggs	July 27—6 eggs
July 24—3 eggs	July 28—6 eggs
July 25—4 eggs	July 29—8 eggs.

I found that I could arrange these eggs in two sets of four by their

shape; those of the first set were relatively long and narrow, those of the second shorter and broader (Plate 11).

Incubation.—A week after the last of these eggs was laid, I set about to mark the attendants of the nest with white paint, or rather to make them mark themselves, in the same manner that Whiteface had acquired his distinguishing characteristic. At length three of them touched the paint-soaked brush, acquiring white blotches adequate for their identification; and there was still a fourth whom I did not consider it necessary to bedaub. All four of these anis took turns at warming the eggs, but their shifts on the nest had no regular order and no fixed duration. Sometimes one bird had been on the nest for less than a minute when another came up and sat beside it. The first always departed very quietly almost at once, leaving the latest arrival in full possession. The longest interval that I saw two individuals cover the eggs side by side hardly exceeded a minute. The ani prematurely displaced by another gave no indication either of anger at having what it might have felt to be its rightful turn taken away from it, nor of pleasure on being so soon relieved of a possibly boring task. Many times it stayed quietly in the nest tree while the newcomer incubated. In the afternoon, one ani warmed the eggs for an hour and 18 minutes, with only a single short break when it jumped off the nest to chase a small lizard which came close to it. This was longer than I saw Whiteface or Blackface incubate, although one would have expected the turns on this nest to be shorter, since four birds shared them. On the other hand, the following morning, just after I had entered the blind leaving the anis greatly excited, each of the four took a short turn on the eggs in a period of less than ten minutes. At night, one ani covered the eggs alone.

At another nest near by, also belonging to two pairs, two anis were busy bringing pieces of dead vines and the dried bases of grass tufts to be arranged in the nest by a third individual, who covered the eight eggs. This was a very belated spurt of nest building, for the next day the first egg hatched. These birds managed to hatch all eight of their eggs, although the last nestling was born four days after the first and was wholly naked while its elder nest-mates bristled with long pinfeathers. The eight nestlings were brooded at night by a single parent.

Care of nestlings.—Just as the parents co-operate in incubating the eggs, so they all join in caring for the nestlings. I have watched three nests, each belonging to two pairs, while they contained young. Two of them, I made quite sure, were attended by four adults; but at the other I could not convince myself that there were more than three

attendants. Possibly some calamity had befallen the fourth member of this association, or possibly also I failed to recognize it, since the anis at this nest were unmarked and indistinguishable. I found it almost impossible to make the parents rub against a paint brush except while they were incubating their eggs. If a brush were stuck into a nest which held young, they chewed on it, attempting to swallow it in their insatiable hunger. At one of the nests I became familiar, after a little practice, with all four of the parents individually; for their tails had become much frayed by foraging in the grass and many feathers were broken off near the end, those of each bird in a characteristic fashion.

The nestlings, when hungry, make a loud, sizzling noise, as of something frying in hot grease, and attempt to swallow everything in sight, a finger if it is presented to them, a stick, or a thorn projecting above their nest's rim. At the age of five or six days they scramble out of the nest and hop away through the branches of the tree when alarmed. Since they can support themselves hanging by one foot, they do not usually fall to the ground. While they try to escape, the parents may vigorously buffet the head of a human intruder, continuing this as long as he remains by the nest and at times almost knocking off his hat. At some of the joint nests I received far more bumps than at Whiteface's nest. Except when the nestlings are very small, the parents do not clean the nest in the manner of passerine birds, but the young anis squirt their excrement over the side. Thus the provisions for the sanitation of the nest are essentially the same as in hummingbirds, in which also the parent removes with her bill the droppings of very small nestlings, while older ones eject their excreta over the rim. But whereas this method suffices to keep the hummingbird's tiny cup perfectly clean, the long, projecting sticks of the ani's nest are befouled by the ejected droppings. Thus a nest with young soon acquires a characteristic odor by which it is possible to detect its presence.

The anis are late to begin their day's activities, for they dislike to wet their plumage by foraging amid herbage still heavy with dew. While early birds are busy stuffing their young, the anis prefer to rest on some exposed perch, spreading their wings to the slanting rays of the rising sun. Meanwhile, one of the parents remains quietly brooding the little ones in their nest. It is eight o'clock or later when they begin to feed their nestlings in earnest, but then they do so with great energy. The three (or possibly four) attendants of the nest mentioned above brought food to their eight nestlings 66 times in two hours, or at the rate of about 4.1 meals per nestling per hour. In

their eagerness to be fed, unfeathered young often climb upon the rim of their nest, trying so to gain an advantage over their nest-mates. Their food consists principally of grasshoppers, but includes cockroaches and other insects, spiders, an occasional small lizard and a rare berry. Very small nestlings manage to swallow surprisingly large grasshoppers; but sometimes two of the parents, standing on opposite sides of the nest, prepare a particularly large one by pulling it apart between them, and each gives its half to a youngster. Although parent birds of many kinds try patiently for minutes together to induce a nestling to swallow something beyond its capacity, very few co-operate with their mates to reduce the size of such an article, in the manner of the anis.

The efforts of the parent anis to separate a lizard into swallowable portions are not always successful. Once I saw an ani bring to the nest a lizard of moderate size, already dead, and offer it to a nestling, whose best efforts to swallow it were of no avail. The parent took it up again and perched with it in the nest tree, calling for help, until another attendant arrived. Standing on the rim of the nest, the two tried to tear it apart between them, but they succeeded only in pulling it out of each other's bills in turn. Then one again presented it to a nestling, with no better result than last time; so it carried the victim to a clear space on the ground and struggled for ten minutes in a vain attempt to shake and beat it into pieces. Tiring of this fruitless effort, it again took it to the nest and offered it to a nestling; but it had scarcely diminished in size and none of the brood could swallow it. Now a second parent returned to the ground with the reptile and tried to accomplish what the first had failed to do, but after five minutes it abandoned the attempt and brought it to the nest a third time. Now a nestling made a brave effort to swallow the lizard, but this was physically impossible; a parent took it away and flew off with it, and I saw it for the last time. Sometimes a youngster manages to gulp down all of a small lizard but its long tail, which then projects into the air and waves from side to side with the nestling's movements, until it finally disappears.

RELATIONS WITH THE SMOOTH-BILLED ANI

For some obscure reason, anis have not colonized the rapidly expanding clearings in the valley of El General in Costa Rica as rapidly as many associated birds of open country have done, and of all the agricultural districts of Central America at lower altitudes with which I am familiar, this has the sparsest population of Groove-billed Anis. As already mentioned, I have found here only a single completed nest

in the past twenty years. Strangely enough, the Pacific side of southern Costa Rica, where the Groove-billed Ani—the common species of Central America—is so scarce, is the only part of the mainland north of the Isthmus of Panamá where I have met the Smooth-billed Ani, a rare straggler in most of Central America. In 1947, in the coastal lowlands between the mouth of the Río Térraba and the Golfo Dulce, I found the Smooth-billed Ani but not the Groove-billed, and a nest of the former species was discovered on September 18. In the valley of El General, however, the Groove-billed Ani is the more abundant of these two species. In 1940, I found both of them together in a pasture with scattered bushes beside the Río San Antonio, an affluent of the Pacuar near the head of the Térraba Valley. The concurrence of these two kinds of anis must be not infrequent in Venezuela, Colombia and Ecuador west of the Andes; but this is the only point where I have enjoyed the opportunity to observe their interactions.

On March 12, I recorded the presence of four Smooth-billed Anis—the first I had seen in El General—following cattle in the pasture beside the Río San Antonio. During the next month I had little time to devote to these birds, but on April 8 I was surprised to see one chasing another and to hear the unmistakable soft *pihuy pihuy* of the Groove-billed Ani coming from the fugitive, while the pursuer voiced the whining *ooenk ooenk* of the Smooth-billed Ani. While the latter continued to drive the Groove-bill away, two other Smooth-bills rested in a bush; and here the third came to join them after the fugitive had fled to a satisfactory distance. Two perched side by side, by turns preening each other's plumage. But the soft-voiced Groove-bill did not wish to be deprived of the company of the only other anis on the farm and persisted in attempting to join them. Every time it came near, one or another of the Smooth-bills (I could not tell whether it was always the same) drove it off again, and it fled voicing the soft calls so different from the notes of the pursuer.

Through the remainder of April and most of May, or over a period of no less than six weeks, the lone Groove-billed Ani persisted in its efforts to attach itself to the little flock of Smooth-bills, but it was ever as ungraciously repulsed. Meanwhile, I had found a party of about seven birds of the former species high up on the slope of the mountain at whose foot this little drama of thwarted affections was enacted. A belt of forest possibly a thousand feet in width, in addition to some open fields, separated this group of Groove-billed Anis from the solitary individual of their kind and the three Smooth-bills. Since anis are poor fliers and avoid forest, it seemed most improbable that the isolated bird would soon find the others of its own species.

A long and circuitous course might have taken it to the flock of seven without the necessity of passing through or over the woodland, but I had no great hope of its repatriation.

Day after day the lonely Groove-bill hovered in the vicinity of the three Smooth-bills and was driven off innumerable times. Once I saw one of the latter take over the chase of the unwanted one after another had grown tired; hence it aroused the antagonism of more than one of the trio. But the Smooth-billed Anis were even poorer fliers than the Groove-bill, who easily eluded the pursuers, and ever and again circled around to rest once more in their neighborhood, and to be driven off when it ventured too near. In the evening, I would sometimes find it perching all alone in a bush in the pasture, after the others had retired to sleep together amid the denser shrubbery beside a brook. A bird of companionable disposition, it yearned for company at the roost, but could find none. It symbolized the tragedy of a social creature unable to find others of its kind.

At the end of April a fourth Smooth-billed Ani arrived and I saw it perching near the other three, while the soft-voiced outcast hovered in the offing, and was driven off whenever, uttering its alien call, it attempted to come too near. That evening, while watching the flock go to roost, I learned that the fourth Smooth-bill had not been wholly accepted as a member of the little flock. After considerable moving about, three of the Smooth-bills retired into a small, loose clump of bushes and young trees in the midst of the open pasture. When the fourth individual of their kind tried to join them there, one of the others sallied forth from the clump and chased it beyond the rivulet a hundred yards away, then returned to its companions in the clump, while the chased bird remained out of sight amid the bushes. The preceding day I had noticed signs of antagonism between the Smooth-bills, yet they seemed to be getting along together better than with the Groove-bill.

The Groove-billed Ani, who as usual had been driven about during the late afternoon, perched quietly on the top of a small shrub, while the three Smooth-bills settled down for the night after driving away the fourth. Then, flying from bush to bush, sometimes calling its soft *tiho tiho* as it went, it gradually approached the clump where the three it wished to have as companions rested. When it had nearly reached the bushes, one of the Smooth-bills came out and chased it back to the rivulet. Among the bushes on the steep slope bordering the brook the pursuit continued, the Smooth-bill persisting in the chase of the Groove-bill, who now stubbornly refused to retreat farther, but merely circled and doubled around, easily eluding the chaser.

Sometimes the Smooth-bill came to rest in the same bush where the fugitive had paused; for a brief period both of the black birds would catch their breaths while perching close together in apparent amity; then the Smooth-bill would renew the pursuit as before. I never saw one strike or grapple with the other.

After a good deal of this circling about among the bushes along the rivulet, the Smooth-billed Ani desisted from the useless pursuit and returned to the clump where the others were resting. Now the Groove-bill perched conspicuously on top of a bush and gave voice to soft, mournful notes, full and continuous, unlike any utterance that I had ever before heard from an ani. After a long pause here, while the light was fast fading from the sky, it began to approach the clump by slow degrees, flying from bush to bush, pausing on the top of each to look around and consider and repeat its mournful notes. By this slow approach it had almost reached the clump where the others roosted, when one of the three flew forth and drove it away. This time, pursuit was not long continued; the assailant soon turned back to the clump, leaving the solitary Groove-bill perching atop a low shrub at no great distance. But after this latest rebuff the poor bird had no heart to make another attempt to join the exclusive Smooth-bills. After pausing here a while in the failing light, it turned about and flew down to sleep alone among the bushes by the rivulet, calling *pihuy* softly as it went.

As so often happens in such cases, the ani would not, or could not, disguise the feature in which it differed most conspicuously from those with whom it wished to associate—in this instance, its voice. For a long while I suspected that it was not permitted to join the three Smooth-billed Anis because it was of a distinct species and spoke a different language. But later, when the fourth Smooth-bill was repulsed, it became evident that these anis were clannish to a degree which I had not suspected of them. The Groove-billed Ani was in much the same situation as another Smooth-billed Ani who had not been accepted as a member of the flock.

Origin of Communal Nesting and its Relation to Brood Parasitism

There has been much speculation on the origin of the communal nesting of anis, and attempts have been made to relate it to the parasitic habits of the European Cuckoo and other members of this family. Some writers have detected in the absence of sharply delimited stages or phases in the nesting cycle a predisposition to other irregularities. We have seen how slowly the Groove-billed Ani works up to full constancy in incubation, and how it may lay its eggs before its nest is

finished or build up its nest when the eggs are about to hatch. However, by no means all birds, even of species in which the strictly monogamous pair breeds in solitude, complete their nest before they start to lay and cease to add to it after incubation has begun, as seems usually to be the way among oscines. In the Passeriformes, many of the Tyranni, especially ovenbirds (Furnariidae) with their often bulky nests, continue to build until the eggs hatch, and even a few Passeres do this, as, for example, certain titmice and wrens. Yet the absence of sharply delimited phases in the nesting operations does not lead to communal nesting or parasitism in these groups.

As we have seen, Groove-billed Anis are usually monogamous; even at joint nests there is strong evidence that monogamy prevails. Moreover, an isolated pair is quite capable of rearing a brood, and about half of the nests belong to such single pairs. Social nesting appears to have arisen simply from the strong social attraction among anis and the absence of territorial defense. Although I have watched Smooth-billed Anis chase an individual of their kind who was not a member of their flock, and Davis (1940) reported vigorous territorial defense by the flock in this species, I never saw a Groove-billed Ani pursue or quarrel with any other Groove-billed Ani. Many highly gregarious birds, such as swallows, preserve an "individual distance," in some cases determined by the reach of their bills while they perch, within which they do not tolerate another individual of their own kind, and which even the future mate is not permitted to enter until by appropriate ceremonies the mutual distrust of the two individuals has been overcome. But the anis do not even attempt to preserve this small individual "territory" which moves about with them. They show not the slightest aloofness from each other, but seem never so content as when they perch in a compact row and nibble each other's plumage. Since the group does not break up at the onset of the breeding season, but its members merely pair off within the flock, it will often happen that two or more pairs are attracted to the same nest site, or perhaps are led to prefer it by the imitativeness so widespread in social animals. The anis seem to be equipped with no aggressive or defensive displays which the pair first in possession might employ to repel their neighbors who trespass on the site of their choice, and the attraction of a superior site readily leads to building and laying in it by more than one pair.

The peculiar nesting habits of the anis, their lack of a territory held by a single pair, are worthy of consideration from both the ecological and the psychological viewpoints. From the former, we wish to know whether the joint nests are more or less efficient in pro-

ducing offspring than those attended by a single pair, and if more efficient, up to what number of co-operating pairs does their efficiency increase. Likewise, we wish to know how the communal habit affects the density of the population. Unfortunately, we possess few data which might help to answer these questions. I know of two instances in which Groove-billed Anis succeeded in hatching all eight of the eggs in nests belonging to two pairs, and a case in which 13 of 15 eggs hatched was reported to me by a reliable observer. Groove-billed Anis seem rarely to lay more than 12 eggs in a nest. On the other hand, Smooth-billed Anis sometimes lay twice this number or even more, yet Davis (1940) never knew more than eight eggs to hatch in one nest. Probably in both species a larger proportion of the eggs hatch in the smaller sets, which can be more efficiently incubated: although the great resistance of anis' eggs to chilling (as I have seen especially in the Smooth-billed Ani) would permit many to hatch even if they were not constantly and uniformly warmed by the single bird that sits on them at one time. But the less efficient incubation at the joint nests with a large number of eggs, and the tendency of eggs to be lost from such nests, may be offset by the more efficient defense against predators. We have seen that Groove-billed Anis are very bold in attacking men who molest their nests; but unfortunately we do not know how they deal with snakes, hawks, small mammals and other predators, nor how often they succeed in protecting their eggs and young from them. One cannot infer from a bird's behavior in the face of one kind of potential predator how it will act toward another, and some birds very timid where man is concerned are bold enough in attacking snakes or other animals.

One of the functions ascribed to territory is the regulation of the density of the breeding population and keeping it in balance with the supply of food; but its efficacy in this connection has been questioned by Lack (1954) and others, largely on the ground that territories are in some species highly compressible in the face of competition for them. However, since this compression is usually not effected without more or less strong resistance by the pairs already established, and as the resulting strife will in many instances reduce the period which the birds devote to actual nesting and the number of broods they can rear or the number of renesting attempts they have time to undertake, even unsuccessful efforts to maintain territories should at least slightly decrease the rate of reproduction; and in the long run this slight depression may be of some importance. The observations of Beer and his colleagues (1956), showing that on small islets isolated pairs of certain songbirds may reproduce in areas far smaller than

they defend when in contact with other pairs of their kind, make it seem probable that some birds hold territories considerably larger than they require as a source of food; and this would act as a check on the density of the breeding population which is independent of the supply of food at the season when it is most abundant.

In anis we should expect that the higher the density of the population the more joint nests there would be, or the more participants each such nest would, on the average, have. We should look for this effect if only because the more abundant food in areas unoccupied by anis, or thinly populated by them, would counteract their strong sociability and lead them to disperse. And if, as seems true, joint nests with more than two or three participating pairs are less efficient than nests with fewer eggs, the very lack of territory held by single pairs would in these birds produce one of the results which have been ascribed to territory—that of placing a check upon the rate of increase. Nature has many means of accomplishing the same end.

In my opinion, there is no connection between the communal nesting of anis and the brood or "social" parasitism of certain other cuckoos. The anis do not represent a stage along the road to such parasitism. Even if, as Davis (1940) believed to be true of the Smooth-billed Ani, some individuals fail to attend, or attend laxly, nests in which they have laid eggs, it is difficult to understand how parasitism of the sort exemplified by the cowbirds and the European Cuckoo could develop from this propensity. If reproduction is to be successful, any deficiency in the strength of the parental instincts of some of the individuals which have laid in a nest must be compensated by increased attentiveness on the part of certain others. Even if there exist in the species genetically determined propensities toward greater and less participation in parental offices, they could hardly, by any known mechanism, be segregated, yielding a species with strong parental impulses and another species devoid of them, without the isolation of these two strains; and this would promptly lead to the extermination of that strain which depended upon the other to rear its young. To take the first step toward brood parasitism, anis would have to deposit their eggs rather frequently, not in nests belonging to other individuals of their own species, but in nests of other kinds of birds. Although such laying in foreign nests occurs from time to time in North American species of *Coccyzus* and certain other non-parasitic cuckoos, it seems hardly ever to occur in the case of anis. Miller (1946) discussed the relation of scattered eggs to parasitism.

Davis (1942), who believed that the "Crotophaginae represent not a stage in the development [of parasitism] but an offshoot," thought

also that these birds are "indolent in the care of the nest." This is certainly not true of the Groove-billed Anis. If at times they build their nest in a desultory fashion, the same applies to many other tropical birds which start their nests long before they are ready to lay and so can afford to construct them at their leisure. In case of necessity the anis can, as we have seen, complete a nest quickly enough. They are slow in warming up to the task of incubation, yet finally they keep their eggs almost constantly covered (which many other tropical birds of which the two sexes share incubation fail by a great deal to achieve); and the adequacy of their attentiveness to the eggs is attested by the incubation period, which is shorter than that of many passerines of similar size. In the defense of their young against man, they are more zealous than any other tropical American birds that I know, except a few of the antbirds. In short, the Groove-billed Anis reveal not the slightest weakening of any of the "instincts" concerned with reproduction save that of territorial defense; they may, like the Smooth-billed Ani, defend a territory belonging to the flock as a whole against others of their kind, but I saw no indication of this. It seems to me that the social nesting of the anis is not even an offshoot of the parasitic habit, but a wholly independent development in an ancient, widespread and highly diversified family; just as colonial nesting and brood parasitism are independent developments in the Icteridae. If it is absurd to suppose that the colonial, polygamous oropéndolas and caciques, with their extraordinarily elaborate nests, represent a stage along the road to the cowbirds which build no nests, it is equally unlikely that the anis, with their strong parental instincts, are in danger of degenerating into brood parasites.

SUMMARY

Groove-billed Anis need trees or bushes for roosting and nesting and open areas covered with low herbage for foraging, but they are tolerant of a wide range of ecological conditions. They inhabit clearings in the rain-forest, semi-desert areas with cacti and thorny scrub, and even extensive marshlands, if there are a few outstanding trees or bushes. In Central America they range from sea level up to about 5000 feet in Guatemala and 7500 feet in Costa Rica, but they are most numerous at lower altitudes.

Exceedingly sociable, they live most of the year in flocks containing 10 to 20 birds. They often perch in closest contact, alternately preening each other's feathers. They were never seen to quarrel or disagree. Disliking wetness and coldness, they often sun themselves with expanded wings.

Their diet consists largely of insects, varied by lizards and small fruits. They forage much amid low herbage, where they either hop with the feet together or run advancing their feet alternately. They follow grazing animals and seize the insects stirred up by them, and sometimes they gather around army ants for the same purpose.

Their breeding season begins late and is at its height in the wet months of July and August. As it approaches, the anis form pairs and often perch two by two, the mated birds in closest contact. Yet many of these pairs remain within the flock and two, three, or rarely more build a joint nest. About half the nests belong to single pairs.

The nest, an open bowl of coarse sticks, weed stems, straws and the like, lined with green leaves, is placed from 2 to 25 feet up in a tree with dense foliage, preferably an orange, or in tangles of vines. In arid regions it is often built in organ cacti and opuntias. Rarely an abandoned open nest of some other bird is refurbished by the anis.

In building, male and female carry and arrange material, but there is a strong tendency for the male to bring sticks and leaves to his mate, who sits on the incipient nest arranging them. When several pairs unite to build a nest, each pair prefers to work alone; but sometimes two pairs are at the nest, and members of both may sit on it simultaneously at this stage.

The eggs are laid around or soon after noon, and at intervals of two or three days. Each female usually lays four eggs, sometimes three or five. Nests containing eight eggs belong to two pairs, those with twelve to three pairs. Nests with more than eight eggs are rare, but one with 15 was recorded.

Incubation is performed by both sexes of all the participating pairs, but two individuals were not seen sitting simultaneously except for a very brief period as one replaced another. At night, a single *male* covers the nest. The anis work up slowly to full constancy in incubation, but in the latter part of the incubation period they keep their eggs almost constantly covered, each bird sitting until replaced by another. At a nest belonging to two pairs, all four of the anis took turns on the eggs within ten minutes when excited, but at this same nest one bird once remained in charge for 78 minutes. The anis continue to bring green leaves and sticks to their nest while they incubate, and they may build actively just before the eggs hatch.

At one nest the incubation period was 13 days.

The nestlings are fed and brooded by both parents or, in the case of the joint nests, by all the co-operating members. Active feeding begins late in the morning, after the herbage has dried, but then it may be rapid. At one nest, eight young were fed 66 times in two

hours by three or four attendants. Large articles are pulled apart between two of the parents, but this method is not always successful with lizards. The parents, especially the males, are bold in defending their young, frequently striking the back of a man's head. They remove from the nest droppings of very small nestlings, while older ones try to eject their excreta over the rim but are not always successful, resulting in the fouling of the outside of the nest.

Hatched without any vestige of down or feather rudiments on their black skin and with tightly closed eyes, the young develop rapidly. When five or six days old they bristle with long pinfeathers. At this stage they leave the nest when alarmed and climb or hop away through the surrounding boughs, often hooking the bill over a twig to avoid falling. When all is quiet, they return to the nest and are brooded. Sometimes they fall to the ground and then they are adept at creeping and hiding in the herbage. Parents fed a fallen flightless nestling, but less than one which remained in the nest.

When the young are six or seven days old their feathers escape with great rapidity from the long, horny sheaths, and a single day brings about a transformation in their appearance (Plate 10). They now enter a half-scansorial, half-terrestrial stage of existence. At one nest the young were last brooded by night when between seven and eight days old. They remained in the nest tree two days longer but did not return to sleep in the nest. Then they were led away by their parents, although they could still scarcely fly. When 11 days old, they could make short flights between the limbs of the same bush.

Two broods may be produced in a season, and the young of the first brood stay with their parents while they rear the second brood. One young ani fed nestlings of his parent's second brood when 72 days old. He also defended the nest.

A Groove-billed Ani, isolated from all others of its kind, tried for more than six weeks to join a flock of three Smooth-billed Anis, but was always driven off by them. They also chased away a fourth Smooth-billed Ani.

Groove-billed Anis show no weakening in any aspect of parental behavior and are exceptionally zealous in the defense of their young. Their communal nesting seems to result merely from their intense sociability. It appears to be not a stage along the road to brood or "social" parasitism, nor an offshoot of such parasitism, but a wholly independent development in a very ancient and diversified avian family.

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BENT'S LIFE HISTORIES OF NORTH AMERICAN BIRDS

The Smithsonian Institution has accepted for publication as a Bulletin of the United States National Museum the first volume of "Life Histories of North American Cardinals, Grosbeaks, Buntings, Finches, Towhees, and Allies," written by A. C. Bent and a large number of collaborating authors. This volume comprises the species in the genera *Richmondena* through *Pipilo*, following the order of the 1957 A.O.U. Check-list. Over fifty authors are engaged in preparing a second volume, which will complete the *Fringillidae*—and the Bent series.—WENDELL TABER.

ON THE BREEDING DISTRIBUTION PATTERN OF NORTH AMERICAN MIGRANT BIRDS

BY ROBERT H. MAC ARTHUR

The first review of the Palearctic migration system as a whole "in its essential aspect as a seasonal ecological adjustment on a gigantic scale" was provided by Moreau (1952). The Nearctic, too, has a migration system and certain aspects of this system can be studied much more thoroughly than is possible at present for the Palearctic, for there is more accurate census data from undisturbed North American areas. It is the purpose of this paper to present information about the pattern of breeding distribution of Nearctic birds which migrate into the Neotropical region.

For present purposes, a Nearctic species will be called a "migrant" if most of the area of its winter range as outlined in the A.O.U. Checklist (1957) lies within the Neotropical Region as outlined by Darlington (1957). (Roughly, as here defined, the Neotropical Region covers all the American continent south of the United States, including the West Indies, but excepting the Mexican highlands; the Nearctic Region is the area north of the Mexican border, plus the Mexican highlands.) The species treated should properly be called "Neotropical migrants," but for brevity the term "migrant" will be used with this meaning throughout this paper.

Although this definition of migrant neglects the many species which move shorter distances within the Nearctic, it is relatively objective, and provides a basis for drawing some general conclusions. Water birds present a rather separate problem from other birds and so are excluded. Game birds and birds of prey constitute such a small proportion of the total number of species or individuals that the question of whether to include them will have little bearing; for consistency they have been included.

It is rewarding to consider an individual about to start its northward migration. Since its destination is presumably a result of natural selection (at least in part), it may be postulated that the individual will tend to breed in the area which permits it the greatest output of reproducing progeny. Figure 1 shows, in black, the proportion of migrant individuals in the breeding populations of various relatively undisturbed vegetation communities in North America. The underlying data are in more detail in Table 1. The extent of the forest biomes (Pitelka, 1941) is shaded in the figure. The proportion of migrant individuals is taken from breeding bird censuses from the areas listed on Table 1. The census species regarded as neotropical migrants are listed in the Appendix. Censuses from obviously

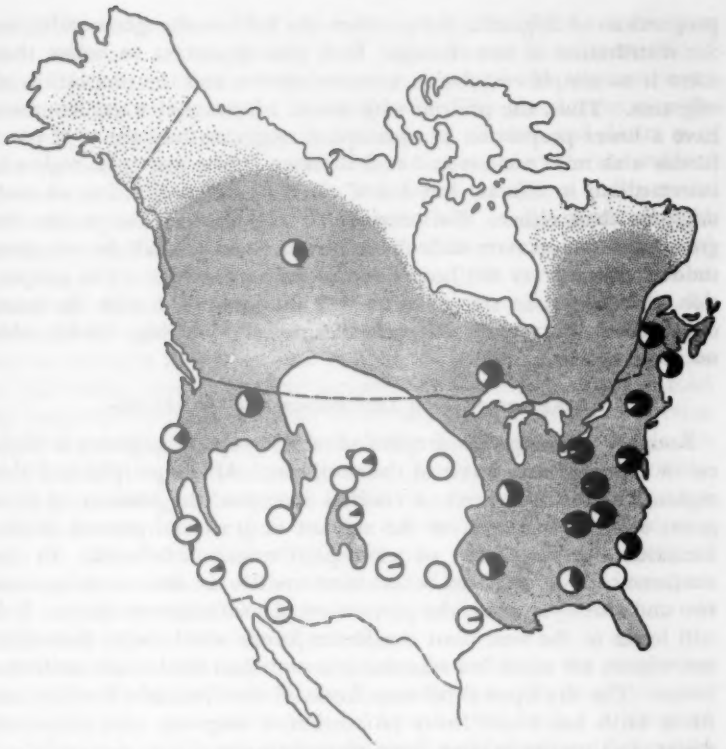

FIGURE 1.—PROPORTION OF NEOTROPICAL MIGRANT INDIVIDUALS. The black sectors of the circles represent the proportion of breeding bird individuals in undisturbed vegetation communities at that locality which will migrate out of the Nearctic region in the winter. The stippled zone is roughly the forested region. The species regarded as neotropical migrants are listed in the Appendix.

man-modified habitats have been omitted, the censuses used being of essentially "virgin" (or at least climax) areas. These undisturbed areas have changed sufficiently slowly and have been present sufficiently long to have their own characteristic bird fauna; this is in contrast to cultivated areas whose fauna has usually come from other habitats such as prairies, shores, and tundra. Thus the censuses from undisturbed areas are more likely to represent the conditions for which the pattern of migration gradually evolved.

EFFECT OF CLIMATE

The first thing to note is that nearby censuses usually show similar

proportions of migrants, except when the habitat changes rapidly; so the distribution is not chaotic. It is also important to notice that there is no simple correlation between climate and the proportion of migrants. Thus, the prairies with severe winters and warm summers have a lower proportion of neotropical migrants than the west coast forests with mild winters and cool summers. The east coast region is intermediate in climate but has a much higher proportion of such migrants than either. Furthermore, at the edge of the prairie the gross aspects of climate such as temperature and rainfall do not show sudden changes, yet the proportion of migrants does. (The proportion of migrants in the avifauna was also compared with the more complicated climate-vegetation classification of Holdridge (1946) with no more success.)

Correlation with Differences in Vegetation

Roughly speaking, the proportion of neotropical migrants is highest in the deciduous forest of the northeast. At the periphery of this region where the amount of conifers increases, the amount of evergreen oak etc. increases, or the amount of grass and general aridity increases, the proportion of neotropical migrants falls off. In the northern coniferous forests, where most needles are shed when between two and three years old, the proportion of such migrants drops. It is still lower in the west coast coniferous forests which, with their mild wet winter, are much less seasonal in aspect than the boreal coniferous forest. The dry open coniferous forest of the Colorado Rockies and Black Hills has a still lower proportion of migrants, and chaparral, desert, and prairie habitats have virtually none.

On the available evidence, the most reasonable explanation of the pattern shown in Figure 1 is that where change between winter and summer in the supply of food suitable for migrants is greatest, the proportion of migrants is greatest. Since direct measurements of food supply are not available, the following rough indication must suffice. Although some of the suggested explanation seem slightly *ad hoc* or at least tenuous, there is little doubt about their validity for the major effects. There is little doubt that the northeastern forests which are 100% deciduous have great summer outbreaks of defoliating insects, and, on the other hand, that there is much less seasonal change in supply of insects in the western habitats which have virtually no migrants.

A more detailed analysis is as follows. The food increase which governs the proportion of migrants must be moderately predictable. Thus, a summer increase in food depending upon a desert bloom

which may take place at various seasons or not at all for several years is of little use to a migratory bird population. The summer food must also last a sufficient length of time to supply the migrant population during its stay in the breeding area. The grasshopper population of the prairies may fail in this respect. Prairie and desert may also provide a large seed crop which the more omnivorous resident species can utilize in the winter. This makes possible a high population of residents, which in turn permits them to use much of what summer insect increase does occur. For these reasons, desert and prairie areas would be expected to provide little summer increase or else little winter decrease in food for migratory bird species. By contrast, the most obvious seasonal change in wooded areas of severe cold or drought is the loss and renewal of leaves. A host of species of defoliating insects and their parasites are an obvious source of food for insectivorous birds, and they do in fact provide the major portion of the food of migrants (Mitchell, 1952; McAtee, 1932). With this in mind it is not difficult to provide tentative explanations of the varying percentages of migrants in the remaining regions of Figure 1. Coniferous trees retain their needles for two or three years and may thus be considered about 40% deciduous, compared with 100% in the angiosperm forests of the northeast. Therefore, the high proportion of migrants in the northeast and the lower proportion in all coniferous forests are to be expected.

Within the coniferous forest, there is a variation in the proportion of migrant individuals, northern spruce-fir forest having more migrants than the pine and redwood forests farther south. A tentative explanation is as follows. Spruce and pine have about equal densities of insects per unit volume of compressed foliage (Kuusisto, 1941), but the ratio of foliage to wood in spruce is 1.5-2 times that for pine (Baker, 1950, page 284). Thus the insect-eating bird might be expected to comprise only half to two-thirds as large a percentage in pine as in spruce. (This explanation is only partly correct; the relative importance of spruce and pine cones and of the under story surely complicate the exact answer.) A difference in shade tolerance is the most likely explanation of the greater foliage/wood ratio in spruce than in pine. Trees, such as various spruce species, that are quite shade tolerant can maintain a thicker layer of foliage before the inside leaves suffer from the lack of light. If this is correct, it may, along with simple food preferences, explain the low numbers of migrants in oak-gum communities of the south and oak forests of the midwest. Oaks are quite intolerant of shade (Baker, 1950) and probably have a small foliage/wood ratio. It is also true that the season when the

TABLE 1

BREEDING BIRD CENSUS DATA OF HABITATS REPRESENTING UNDISTURBED CONDITIONS

Habitat	*Location*	*Reference*	% *migrant*† *individuals*	% *migrant*† *species*	*Ratio migr. ind. to migr. sp.*
Desert					
	California	Hutchinson, 1942	0	0	
	Utah	Fautin, 1946	0	0	
	Arizona	Hensley, 1954	3 (–14)*	7 (–13)	.43
Prairie					
	Oklahoma	Howell, 1941	0	0	
	Wyoming	Mickey, 1939	0	0	
	Iowa	Kendeigh, 1941	0	0	
	Texas	Allan & Sime, 1939	8	12.5	.67
Chaparral					
	California	Cogswell, 1948	0.5	6	.083
Oak Savanna					
	Texas	Dixon, 1957	5	10	.5
Dry Pine					
	Colorado	Thatcher, 1956 Hering, 1956 Snyder, 1950	5,10,19,20	20.5,20,7,30	(.7)**
	S. Dakota	Whitney, 1956	13	30	.43
	Georgia	Fleetwood, 1948	0	0	
Redwood					
	California	Pugh & Pugh, 1957	16	11	1.43
Sitka Spruce					
	Oregon	Fables & Fables, 1957	27.5	17	1.62
Northern Coniferous					
	N.W.T.	Stewart, 1955	37	25	1.48
	Ontario	Kendeigh, 1947	74	40	1.85
	Idaho	Longley, 1944	63	50	1.26
	Maine	Stewart & Aldrich, 1952	72	48	1.50
	Maine	Cadbury & Cruickshank, 1941	62	33	1.88
Oak-Gum					
	Alabama	Imhof, 1948	43	53	.81
	Illinois	Snyder et al, 1948	62	59	1.05
Hammock					
	S. Carolina	Mellinger, 1948	63	65	.97
Oak-Pine					
	Arkansas	Hoiberg, 1957	59	47	1.23
Hemlock					
	N. Carolina	Odum, 1947	75	59	1.27
Northeastern Deciduous					
	New York	Kendeigh, 1946	82	61	1.34
	Ohio	Williams, 1947	87	50	1.74
	Maryland	Stewart & Robbins, 1947	82	60	1.37
	Tennessee	Aldrich & Goodrum, 1946	84	67	1.25
	W. Virginia	DeGarmo, 1948	89	71	1.25

† See Appendix for species regarded as "migrants," i.e., neotropical migrants.

* The figures in parentheses hold if Wied's (Arizona) Crested Flycatcher (*Myiarchus tyrannulus*) is considered a migrant.

** Refers to a mean of the ratios of the four habitats.

leaves are on the trees is much longer in the south, at least, which may make less probable a seasonal insect bloom of the type utilized by migrants. Thus, the information supports the suggestion that migrating birds tend to breed in the areas with the greatest available food supply during the nesting season.

Correlation with Latitude

There is another interesting feature summarized in the table of censuses. For the more northern undisturbed vegetation types censused, the proportion of individuals which migrate to the neotropics is greater than the proportion of species which do not so migrate, as evidenced by ratios greater than one of migrant individuals to migrant species (see Table 1). That is, migrants constitute a greater proportion of the total individuals than of the total species. This means that, in the northern areas censused, the average abundance of the neotropical migrant species is greater than that of the residents and species which move short distances, which are in the table called "non-migrant." (This is not to say that no migrant is rare or no non-migrant abundant; it refers only to averages.) In southern areas, on the other hand, the tendency is reversed, as evidenced by ratios less than one, meaning that, on the average, "non-migrant" species are commoner. The trend with latitude seems quite consistent and appears to be nearly independent of the nature of the particular undisturbed habitats censused. No one explanation of this pattern is obviously correct; a proper weighing of the possibilities will probably have to wait until a better understanding has been achieved of the factors controlling relative abundance of species.

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Summary

1. Over a variety of undisturbed habitats throughout the continent, the density of breeding individuals of species migrating to the Neotropics seems to correlate with the contrast between winter and summer food supply in the given habitat.

2. In the undisturbed northern habitats considered, the average migrant to the Neotropics is commoner than the average species which fails to make this journey. The reverse is true in the southern habitats.

Appendix

Nearctic Land Birds, Occurring in the Censuses, Here Considered Neotropical Migrants

Accipitridae: *Buteo platypterus*. Pandionidae: *Pandion haliaetus*. Cuculidae: *Coccyzus americanus, C. erythropthalmus*. Caprimulgidae: *Caprimulgus carolinensis, Chordeiles minor*. Apodidae: *Chaetura pelagica*. Trochilidae: *Archilochus colubris, Selasphorus platycercus*. Tyrannidae: *Tyrannus tyrannus, Myiarchus crinitus, M. tyrannulus, M. cinerascens, Empidonax flaviventris, E. virescens, E. traillii, E. minimus, E. difficilis, Contopus virens, C. sordidulus, Nuttalornis borealis*. Turdidae: *Hylocichla mustelina, H. ustulata, H. fuscescens*. Vireonidae: *Vireo griseus noveboracensis, V. flavifrons, V. s. solitarius, V. olivaceus, V. philadelphicus, V. gilvus*. Parulidae: *Mniotilta varia, Protonotaria citrea, Helmitheros vermivorus, Vermivora peregrina, V. r. ruficapilla, Parula americana, Dendroica petechia, D. magnolia, D. tigrina, D. caerulescens, D. coronata, D. virens, D. occidentalis, D. cerulea, D. fusca, D. dominica, D. pensylvanica, D. castanea, D. striata, D. discolor, Seiurus aurocapillus, S. noveboracensis, S. motacilla, Oporornis formosus, O. philadelphia, O. tolmiei, Geothlypis trichas brachydactylus, Wilsonia citrina, W. p. pusilla, W. canadensis, Setophaga ruticilla*. Thraupidae: *Piranga ludoviciana, P. olivacea*. Fringillidae: *Pheucticus ludovicianus, Passerina cyanea, P. ciris*.

When not all North American subspecies of a listed species are neotropical migrants, the particular subspecies considered a migrant is listed; otherwise, only the species name is given. Some species included (*e.g., Dendroica coronata*) are possibly doubtful; however, their numerical abundance is sufficiently small that their inclusion makes little difference to the data. Many highly migratory species (*e.g.*, most orioles and swallows) are not included, because they did not occur in any of the censuses considered.

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HYBRIDIZATION IN THE RUFOUS-SIDED TOWHEES OF THE GREAT PLAINS

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Introduction

The Rufous-sided Towhee *(Pipilo erythrophthalmus)* is a polytypic species ranging from southern Canada to Guatemala in the west and from Maine to Florida in the east. It is absent as a breeding bird from the western deserts and from the mid-continent prairie grasslands. Wherever this species occurs it inhabits brushy undercover and its local distribution is limited by the occurrence of suitable habitat.

The populations of the western half of the continent and those of Mexico and Guatemala (the *maculatus* group, formerly called Spotted Towhees) have white spots on the scapulars, interscapulars and wing coverts. The eastern populations are unspotted or have an occasional small white spot in the positions which are heavily spotted in western birds.

The degree of sexual dimorphism also varies geographically. The males in all races breeding north of Mexico have black heads and backs. The females in the heavily spotted races are dark gray where the males are black, but in the eastern races the females are rich reddish brown on the head and back.

Differences in song have also been considered to be of value in separating the two groups as different species. The differences are real, but they are bridged by the songs of the Floridan and Mexican populations, and intermediate songs occur in the Great Plains populations.

The nomenclatural history of this species has been covered in detail in a previous paper (Sibley, 1950: 116–119), and the proposal to consider the *maculatus* and *erythrophthalmus* groups as conspecific was accepted by the Committee on Classification and Nomenclature of the American Ornithologists' Union in 1954 (Auk, 71: 312, see A.O.U. Check-list, 5th ed.: 578–582, 1957). Dickinson (1952) has reviewed the character distribution of the populations of eastern North America.

The purpose of the present paper is to describe the secondary intergradation which occurs across the Great Plains between two races of towhees, *P. e. erythrophthalmus* of the northeastern part of the continent and *P. e. arcticus* (a member of the *maculatus* group) of the northern Rocky Mountains and eastern foothills from Alberta to Colorado and Nebraska. This study is based almost entirely upon material collected since 1950.

The term "hybridization" is used here to indicate interbreeding between populations in secondary contact regardless of their taxonomic rank. For a more extensive discussion of this term and its significance see Sibley, 1957.

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MATERIALS AND METHODS

Between 1953 and 1957, 515 adult specimens of *Pipilo erythrophthalmus* were collected in the Plains. Additional material from the following collections has been used for comparisons: Museum of Vertebrate Zoology, U. S. National Museum, Saskatchewan Museum of Natural History, Royal Ontario Museum of Zoology, Manitoba Museum and the Cornell University collection.

Standard measurements (wing, tail, bill from nostril, and tarsus as described in Sibley, 1950: 113 and Sibley and West, 1958: 87) were taken on all specimens. Weights were obtained for most of the recently collected specimens. These data have been treated statistically.

A hybrid index, similar to that used for the Mexican towhee hybrids

(Sibley, 1950, 1954; Sibley and West, 1958) was devised. As previously noted the males of eastern and western populations differ primarily in the degree of dorsal spotting. The females differ in spotting and in the color of the head and back. These characters were used in the hybrid index as follows:

Males and Females

"0" = unspotted coverts, scapulars and interscapulars, but with a large white patch at base of primaries as in typical *P. e. erythrophthalmus.*

"1" = trace of spotting on feathers mentioned above; white patch at base of primaries reduced.

"2" = spotting abundant; white in primary bases about half of maximum.

"3" = only slightly less spotted than typical *P. e. arcticus;* white in primary bases only a trace.

"4" = fully spotted as *P. e. arcticus;* no white at base of primaries.

In addition, the females were indexed for head and back color as follows:

"0" = rich brown head and back as in typical *P. e. erythrophthalmus.*

"1" = slightly "muddied" brown.

"2" = brownish-gray.

"3" = gray, as in typical *P. e. arcticus.*

Thus the males have a hybrid index base of from "0" to "4", the females from "0" to "7".

This index ignores the presence of small white dorsal spots in many specimens of eastern *P. e. erythrophthalmus* far from the Plains. Neither is the head color of eastern females invariably the rich brown of score "0". It seems best, however, to score the Plains specimens on the above scale rather than to attempt to include these variations in the index. The spotting in eastern birds far from the Plains may be due to "ancestral" genes or to recurrent mutations which are favored by selection in local habitats. It is highly unlikely that introgression from the western populations is the only cause, although it may be in progress.

FIELD STUDIES

When the proposal to merge the two groups was made in 1950 very little was known about the distribution of breeding towhees in the Great Plains. Judging from the few specimens available and from the meager literature records it appeared that a contact might be present "in southwestern Manitoba where the two forms have been recorded within 20 miles of one another" (Sibley, 1950: 119). To test this hypothesis the senior author visited parts of North Dakota and Manitoba in July, 1953 and collected 11 adults. Localities included the Souris River near Kenmare and near Upham, the Turtle Mountains and the Pembina River. Towhees were uncommon along the Souris River and in the Turtle Mountains but fairly numerous in the brushy cover along the Pembina River near Walhalla, North Dakota. In 1954 Stuart S. Peters collected 26 adults on the Pembina River in southern Manitoba.

When field work on avian hybrids in the Great Plains was begun in 1955 it was assumed that towhees would not be found as common breeding birds in the central Plains. A search of the literature, including such local journals as the Nebraska Bird Review, gave little indication of the presence of this species in the breeding season. It was a surprise therefore to find that towhees are one of the most abundant breeding birds in the riparian thickets of the Plains. Along the Niobrara River the population density is as high as any we have encountered in the United States or Mexico.

Between 1955 and 1957 field parties collected in Nebraska, South Dakota and Colorado. Most of the 478 adult specimens were obtained in Nebraska.

During these several field trips we made an attempt to determine the distribution of towhees in the central Plains. Most of the major river valleys were visited and a search for towhees was made in all areas of apparently suitable habitat. The map (Fig. 1) indicates the localities visited and the average back spotting index for each locality at which towhees were collected. Where no index number appears the birds were not found, or at least no towhees were obtained. Approximately 3 days were spent at each locality. Numbers of specimens and frequencies of hybrid index scores for localities in the hybrid zone are given in Table 1.

The character gradients will be described under four headings: (1) The Platte River Transect; (2) The Niobrara River; (3) South Dakota, and (4) North Dakota and Manitoba.

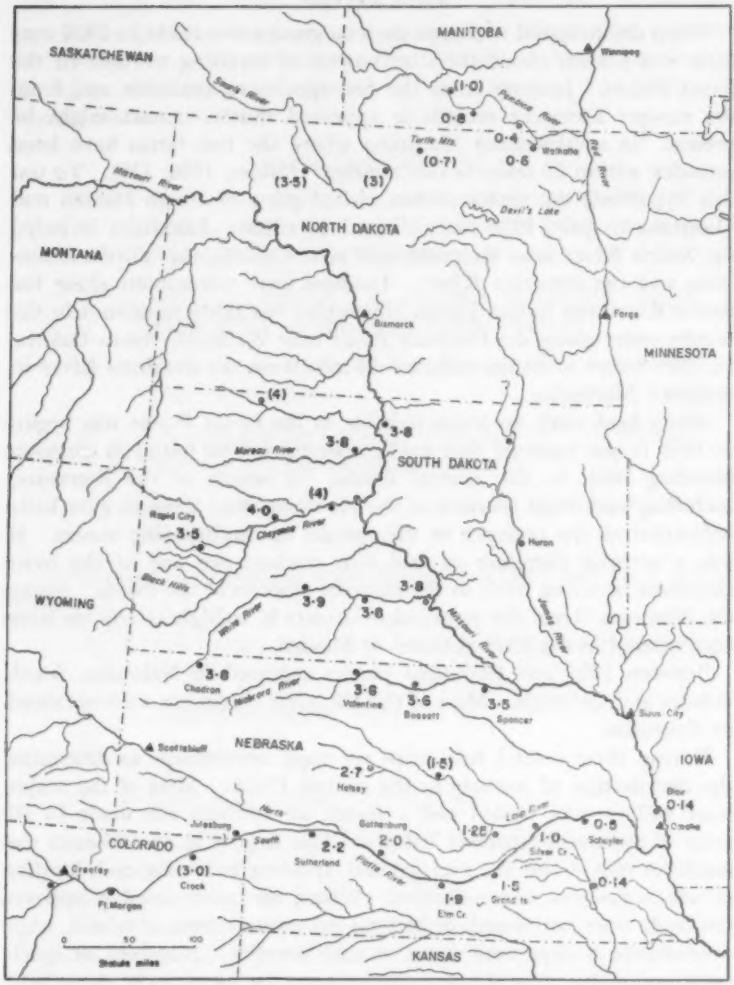

FIGURE 1. Localities mentioned in the text. Solid circles represent collecting localities; average hybrid index for back spotting is given for each locality where specimens were obtained. Where no number appears no specimens were taken. Numbers are in parentheses where fewer than five specimens were collected. Triangles indicate cities.

TABLE 1

FREQUENCIES OF HYBRID INDEX SCORES FOR LOCALITIES IN THE HYBRID ZONE

Locality	*Number* ♂♂	♀♀	*Back Spotting Index* 0	1	2	3	4	*Average*
Crete, Nebr.	6	1	6	1	—	—	—	0.14
Platte River Transect, Nebr.								
Blair and Omaha	11	3	12	2	—	—	—	0.14
Schuyler	13	4	11	4	2	—	—	0.5
Silver Creek	13	3	8	3	3	1	1	1.0
Grand Is. and St. Paul	33	12	8	18	11	7	1	1.4
Elm Creek	23	9	3	11	7	7	4	1.9
Gothenburg	35	14	3	17	8	12	9	2.0
Sutherland	18	2	—	8	3	5	4	2.2
Nebr. National Forest								
Halsey	20	9	—	4	7	12	6	2.7
Niobrara River, Nebr.								
Spencer	8	2	—	—	1	3	6	3.5
Bassett	54	21	—	—	—	18	57	3.6
Valentine	17	7	—	—	—	4	20	3.8
Chadron, Nebr.	18	3	—	—	1	2	18	3.8
South Dakota—White River								
Chamberlain	21	7	—	—	—	5	23	3.8
Murdo	8	2	—	—	—	2	8	3.8
Kadoka	6	3	—	—	—	1	8	3.9
Cheyenne River, S. D.								
N. of Midland	—	1	—	—	—	—	1	(4)
Bridger Creek	7	1	—	—	—	—	8	4
Rapid City	11	1	—	1	—	3	8	3.5
Moreau River, S. D.	21	1	—	—	—	5	17	3.8
Mobridge, S. D.	20	5	—	—	—	5	20	3.8
N. D. and Manitoba								
Walhalla, N. D.	3	2	3	1	1	—	—	0.6
Windygates, Man.	10	3	8	5	—	—	—	0.4
Clearwater, Man.	9	1	4	5	—	1	—	0.8
Riverside, Man.	3	—	1	1	1	—	—	1.0
Turtle Mts., N. D.	2	1	1	2	—	—	—	(.7)
Bantry, N. D.	1	1	—	—	—	1	—	(3)
Kenmare, N. D.	1	1	—	—	—	1	1	(3.5)

1. THE PLATTE RIVER TRANSECT

Suitable towhee habitat in the Plains is found chiefly along the major streams. The Platte River, which flows from west to east across Nebraska, was selected for intensive study because it provides a natural "bridge" of vegetation from the Rockies to the Missouri River.

Our easternmost locality was at Blair, Nebraska on the Missouri River, 25 miles north of Omaha. From this point camps were established at 50 mile intervals along the Platte to Greeley, Colorado on

the South Platte River. This transect covers approximately 500 miles along the river and from 1000 feet elevation at Blair to 4800 feet at Greeley.

The habitat preferred by towhees along the Platte consists chiefly of cottonwoods (*Populus*) with a thick undergrowth of dogwood (*Cornus sp.*), False Indigo (*Amorpha fruticosa*), Prickly Ash (*Xanthoxylum americanum*), Snowberry (*Symphoricarpos sp.*) and other shrubs. The actual understory species vary from locality to locality, but the form of the vegetation is similar. Willow thickets also harbor towhees which were among the common species at each locality to the forks of the Platte. West of this point, on the South Platte River, the strip of riparian woodland is narrower and drier and the cottonwoods are smaller and more scattered. The understory becomes thinner and towhees are uncommon or absent. Four camps were made in Colorado west of the forks of the Platte: Julesburg, Crook, Fort Morgan and Greeley. At Julesburg three towhees were seen, none taken; 50 miles west, near Crook, two males were taken, indexing "2" and "4" respectively in back spotting. West of Crook no towhees were found and the nearest populations are apparently those in the Rocky Mountains above Fort Collins and Loveland, Colorado *(P. e. montanus)*.

Figure 2 shows the frequency distribution of hybrid index scores for the specimens taken at the Platte River camps. The shift per mile in average hybrid index is also indicated. It will be seen that even as far west as Sutherland, Nebraska, just west of the forks of the Platte, the sample averages only "2.2" in back spotting. This westward influence of eastern birds is in marked contrast to the situation along the Niobrara River (see below) where nearly pure western towhees are found far down the river to northeastern Nebraska. The factors which seem to permit these contrasting situations will be discussed in the Niobrara River section.

Although few females were collected along the Platte River, histograms of hybrid index scores for color and back spotting have been constructed. They show a cline similar to that for back spotting alone and have not been included for that reason. The samples of females from Sutherland averages "4.5" in hybrid index on a scale of from "0" to "7".

There is no significant difference between birds from the Missouri River at Blair and those of the forks of the Platte in any of the measurements taken. Samples from Montana *(P. e. arcticus)* likewise are not significantly different from those of eastern Nebraska in mensural characters.

One camp was made in the Nebraska National Forest (Bessey

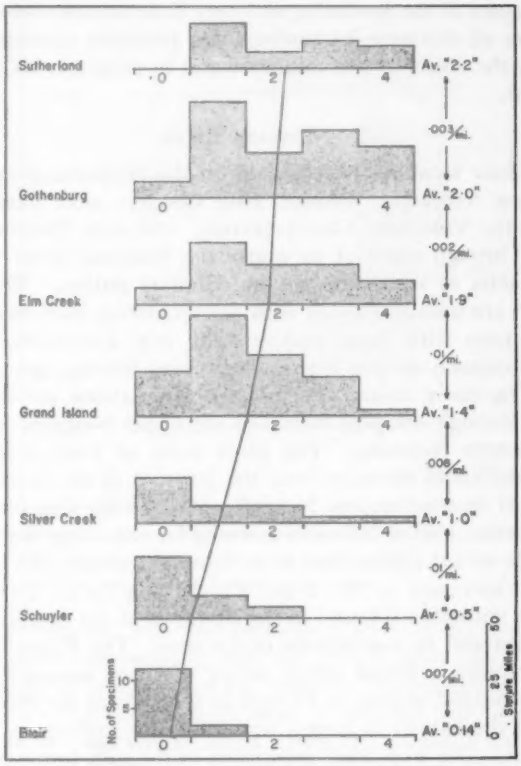

FIGURE 2. Histograms of hybrid index for back spotting for localities in the Platte River Transect. (The Grand Island sample includes eight specimens from St. Paul, 25 miles to the north.) The shift in hybrid index units per mile of river is indicated.

Division) on the Middle Loup River near Halsey in the Sandhills. This forest was planted in the Sandhills grassland starting in 1902, and at the present time a considerable area of native grassland is covered by yellow pine *(Pinus ponderosa)*, red cedar *(Juniperus virginiana)* and other evergreen species. Parts of this forest have sufficient undergrowth to harbor towhees. In 1955, 20 males and nine females were collected here. The average back spotting index of these birds is "2.7". This population is almost totally isolated from the towhee populations of the Platte and lower Loup Rivers, although a small contact must exist with the latter river system. To the north

lies a large part of the Sandhills, with very little suitable habitat. The colonization of this area by towhees was probably accomplished by birds from the rivers to the southeast and by migrants on their way to the north.

2. NIOBRARA RIVER

In 1955 four localities were visited on the Niobrara River and in northwestern Nebraska: Spencer, Holt County; near Bassett, Keya Paha County; Valentine, Cherry County; and near Chadron, Dawes County. Through much of its course the Niobrara River runs in a gorge the sides of which are cut by tributary gullies. These small side valleys are usually wooded with oaks *(Quercus macrocarpa),* elms and other trees with dense undergrowth (e.g. *Symphoricarpos sp.*). Pines are common on the higher slopes and towhees are extremely abundant in many areas. These large populations are apparently connected through the pine forests of the upper Niobrara with those of northwestern Nebraska. The pines occur at least as far east as Holt County, about 60 miles from the junction of the Niobrara with the Missouri in northeastern Nebraska. As can be seen on the map (Fig. 1) spotted towhee influence is strong far east along the Niobrara. The sample of ten adults from Holt County averages "3.5" in dorsal spotting (1 specimen = "2", 3 = "3", and 6 = "4"). The explanation of this stituation is found in the character of the vegetation along the Niobrara and its connections to the west. The Platte River (see above) occupies a broad sandy valley with an essentially eastern riparian woodland, at least as far west as the forks of the Platte. West from there the habitat is largely unsuitable for towhees, as has been pointed out. The woodland connection to the east, however, is solid. The Niobrara, on the other hand, is wooded with a more western type of vegetation and the habitat has an apparently good contact with the west. There is also a good woodland connection to the east via the Missouri River but the large population of towhees in the western areas apparently exerts a strong influence through the pine forest contact and tends to swamp out eastern towhee genes which might otherwise predominate in north-central Nebraska. The western influence is further strengthened by the fact that eastern towhees are rare north of the Missouri in eastern South Dakota. Thus all eastern towhee influence must come up the Missouri. In southern Nebraska the greater number of wooded streams from the east, which flow parallel to the Platte, certainly helps to permit gene flow from populations of eastern towhees into central and western Nebraska. In northern Nebraska the midpoint in the cline of intergradation will surely be

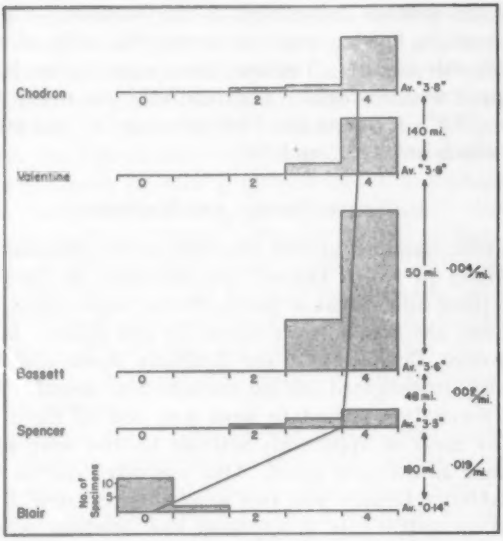

FIGURE 3. Histograms of hybrid index for back spotting for Blair and the Niobrara River localities. See Figure 2 for explanation.

found to lie on the Missouri between Blair and the mouth of the Niobrara River and probably well east of this latter point.

Histograms of hybrid index for Niobrara River localities are shown in Figure 3. The sample from Blair is included also, and the shift per mile of average hybrid index along the Missouri and Niobrara Rivers is shown. Comparison with the similar chart of hybrid index for Platte River specimens (Fig. 2) shows that the shift per mile between Blair and Spencer is more rapid than any along the Platte. Female head color was also indexed and shows a situation similar to that of back spotting alone.

3. SOUTH DAKOTA

In 1955, 11 localities were visited in South Dakota. Two of these were on the James River in eastern South Dakota. The others were west of the Missouri River. The James River was found to be unsuitable for most woodland birds, at least north of Mitchell about 70 miles north of the Missouri River. It seems apparent that there is an important gap between eastern and western towhees between the Missouri River and the woodlands of extreme eastern South Dakota. The existence of a gap is further indicated by the pattern of back

spotting of the towhees taken west of the Missouri (Fig. 1). The absence of streams flowing east-west across this strip of land seems important in this regard. Towhees from west of the Missouri are nearly all pure western birds. The relatively low index average for Rapid City ("3.5") is due to one bird indexing "1" in a sample of 12, the rest of which index "3" and "4".

4. North Dakota and Manitoba

Towhees were obtained at four localities on the Pembina and South Pembina Rivers in North Dakota and Manitoba in 1953 and 1954. In addition three other areas of North Dakota were visited, the Turtle Mountains and the Souris River system in two places. Much of the country between Devil's Lake, the Pembina River and the Turtle Mountains was investigated but no towhees were found. The Turtle Mountains themselves proved to have very few of these birds. Although many areas of apparently suitable habitat were searched for towhees only 3 adults were taken. One was taken on the Souris near Upham, McHenry County and two were obtained near Kenmare on the same river system. It is apparent that towhees occur sparsely across northern North Dakota west of the Pembina River. However, the Pembina itself proved to have many towhees and 31 adults were taken at 4 localities. The map (Fig. 1) indicates the spotting index average for all localities. Although strongly eastern in character the Pembina samples show considerable back spotting, especially in the more western localities. Female head color shows a similar pattern.

Discussion

The geological history of the Great Plains, the present pattern of vegetation and the nature of the character gradients in the towhees of the Plains indicate that the present situation is the result of a secondary contact. During the Pleistocene glaciation the eastern and western populations were presumably isolated by unsuitable environmental conditions in the Plains. After the retreat of the glaciers suitable habitat developed along the streams and birds from both sides spread out along these slender riparian connections and re-established a "filter bridge" type of secondary contact along some of the trans-Plains streams. The post-Pleistocene contact has never been on a broad front and thus the amount of gene exchange has been greatly restricted. The large populations on the two sides of the Plains, each adapted to its own environment, easily swamp alien genes entering from the other side. Presumably selection is also removing alien genes

for there is some indirect evidence that the back spotting pattern is indirectly correlated with climatic differences (see below).

Man has been an important factor in the increase of suitable habitat for some species of woodland birds in the Plains. The planting of trees for various purposes in areas which originally were grassland has enabled the eastern and western populations of such species as the Baltimore Oriole (*Icterus g. galbula* and *I. g. bullockii*) to come into broad, freely interbreeding, secondary contacts. Such plantings have probably had but limited influence on the towhees because of the absence of the required dense undercover in most man-made woodlands. In a few areas, for example the Nebraska National Forest at Halsey, a planted woodland has been permitted to develop understory vegetation and towhees are present. If this type of planting should be greatly increased the extent of introgression would presumably also increase.

The geographic distribution of the dorsal color pattern suggests that it has adaptive significance in some way correlated with climate. The races which are spotted dorsally (*maculatus* group) tend to live in areas which are more arid than those occupied by the unspotted *erythrophthalmus* group. The vegetation occupied by the spotted races is usually a "chaparral" formation of woody shrubs without an arboreal cover. The unspotted races tend to occupy the understory shrubbery of eastern deciduous woodlands, a formation of more humid climates. Common observation indicates that the amount of sunlight reaching the ground and producing a sun-dappled pattern will be greater in a chaparral habitat than in a woodland habitat where the canopy will intercept more of the light. Hence we suggest that the dorsal spotting is a cryptic pattern induced by selection through predation and correlated indirectly with climate through the effects described. This explanation is supported by the fact that the least spotted race of the *maculatus* group is *P. e. oregonus* which occurs in the understory vegetation of the coastal forests of the Pacific Northwest. This is a habitat in which a minimum amount of sun-dappling of the ground would be present. In this connection it should not be forgotten that individuals of the eastern populations are also frequently spotted with white on the back and wing coverts (Sibley, 1950: 116–118). The comparison with *P. e. oregonus* is emphasized by the statement by Miller (1897: 276) who wrote as follows concerning a spotted eastern towhee taken at North Truro, Massachusetts, on August 2, 1889. This bird was ". . . normal in all respects except that the scapulars on each side are conspicuously edged with white. The marking is only slightly less extensive than in a specimen of

Pipilo maculatus oregonus taken at Victoria, B. C., on August 1, 1888. Eastern towhees with spotted scapulars have been recorded before but such specimens are always of interest."

SUMMARY

A collection of 515 adult specimens of the Rufous-sided Towhee *(Pipilo erythrophthalmus)* taken in the Great Plains between 1953 and 1957 is described. A secondary post-Pleistocene contact between the eastern (unspotted) and western (spotted) populations has occurred along the streams crossing the Plains. A gradient in the amount of spotting and in female color character is present. Size differences are not significant.

The present situation is one of normal geographic variation in which the area of contact between the eastern and western groups of races is restricted to the narrow riparian strips of habitat. Selection against alien genes helps to prevent marked introgression in both directions. The differences in degree of white dorsal spotting appear to be adaptive.

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CORRESPONDENCE WITH THE TREASURER

Dr. Charles G. Sibley, Treasurer of the American Ornithologists' Union and Professor of Ornithology at Cornell University, will spend the year from July 1959 to August 1960 in England as a Guggenheim Fellow. Nevertheless, correspondence relating to A.O.U. membership, dues, etc. should continue to be addressed to him to Fernow Hall, Cornell University, Ithaca, New York. Dr. Sibley's personal address in England will be c/o The Edward Grey Institute, Botanic Garden, Oxford.

HEAD-SCRATCHING MOVEMENTS IN BIRDS

BY MARGARET M. NICE AND W. E. SCHANTZ

Birds scratch their heads in two distinct ways. One, practiced by the domestic fowl, is under the wing, *vornherum* as Heinroth (1930) called it, or "directly" (Simmons, 1957). The other, shown by most passerines, is over the wing, *hinterherum*, or "indirectly"; here the wing is drooped and the leg brought up over it. These movements have been considered to be fixed actions, consistently shown by all members of one family and thus having considerable taxonomic significance (Simmons, 1957).

The following birds have been reported to scratch under the wing, the authority being Heinroth except as otherwise noted:

Great Crested Grebe (Simmons, 1955); Great-winged Petrel (Warham, 1956), herons, storks, ducks, geese, swans, hawks, gallinaceous birds, jacana (Haverschmidt, 1957), sandpipers, turnstone (Simmons, 1957), gulls, terns, pigeons, parrots that use the foot in bringing food to the bill (Simmons, 1957; Haverschmidt), ani (Haverschmidt), puffbirds (Haverschmidt), toucans. Scratching under the wing has also been observed by the senior author in the following: Rufous Tinamou *(Rhynchotis rufescens pallescens)*, American Flamingo *(Phoenicopterus ruber)*, Sora *(Porzana carolina)*, Virginia Rail *(Rallus limicola)*, American Coot *(Fulica americana)*, Seriema *(Cariama cristata)*, and by the junior author in the Yellow-billed Cuckoo *(Coccyzus americanus)*.

The following birds have been reported to scratch over the wing:

Oystercatcher, plovers, stilts, avocets, sand grouse, some parrots (Simmons, 1957), goatsuckers, swifts, hummingbirds (Haverschmidt), kingfishers, bee-eaters, hoopoes, barbets, hornbills, most woodpeckers, most passerines. As to these last two groups Heinroth (1930: 338) says merely: *"fast alle Singvögel (Passeriformes). . . . und meist auch die Spechte"*. ("almost all songbirds (Passeriformes) . . . and also most woodpeckers"). In addition the senior author has observed King and Little Penguins *(Aptenodytes patagonica* and *Eudyptula minor)* scratching over the wing.

Simmons (1957) gives a long list of passerines watched in the London Zoo; all of them scratched over the wing except Timaliidae. The Fickens (1958), however, report various nestling passerines as scratching under the wing, before switching to over the wing, among them their hand-raised Northern and Louisiana Waterthrushes *(Seiurus noveboracensis* and *S. motacilla)*. Ovenbirds *(S. aurocapillus)*, on the other hand, scratched under the wing both in the nest and as adult.

The junior author of the present paper has made a long series of experiments on this subject with birds captured for banding. Pieces

of gummed paper were attached successively to chin, lores, ear patch and crown, and the response of the bird noted and in many instances photographed. The subject was placed in a cage lighted by a 15-watt fluorescent lamp or by Christmas tree bulbs of 3 colors. The camera was focussed on the perch through the side of the cage. The observer watched through an 18 inch slot from the dark outside. Time was allowed for the bird to become accustomed to the set-up, and sounds such as that of a vacuum sweeper or static on a radio had a calming effect on the warblers but not on the thrushes. Birds often bathed or ate or preened after a brief period in the observation cage.

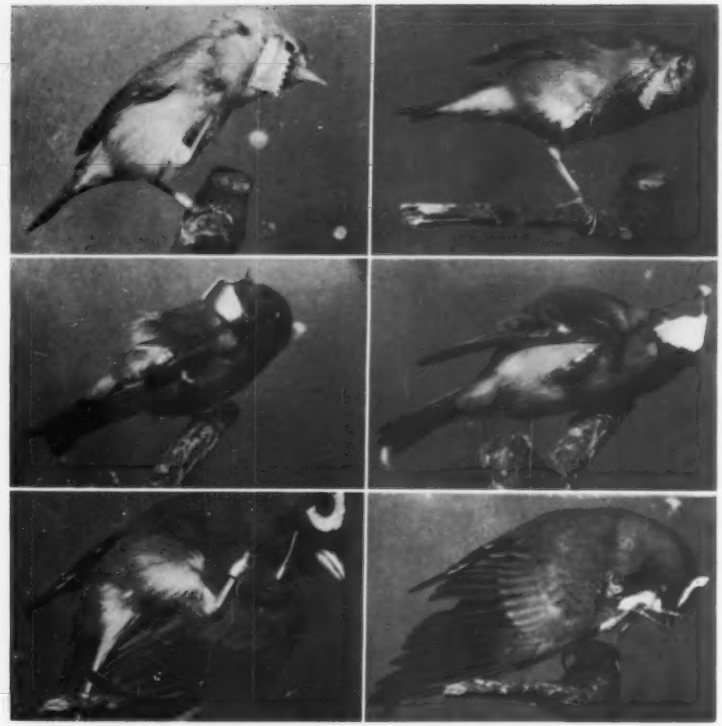
When the patch was first applied, most of the birds dashed about in alarm, at the same time scratching. When the patch was removed and applied elsewhere the bird was usually less alarmed, but otherwise responded in much the same manner as during the first test. There was no indication of trial and error learning, but rather of random reactions to discomfort. The most pronounced scratching followed when patches hindered vision and when feathers beneath the patch had been ruffled.

A great many records were obtained on 207 individuals of 40 passerine species, and 113 photographs were made of birds scratching their heads. One hundred and fifty-three birds of 25 species scratched consistently over the wing, while 35 birds of 7 species scratched consistently *under the wing.* Surprisingly enough, 19 birds of 8 species *used both methods.*

Much variety was found among the 19 species of Parulidae tested. One Hooded Warbler *(Wilsonia citrina),* 2 Yellowthroats *(Geothlypis trichas)* and 3 Redstarts *(Setophaga ruticilla)* scratched over the wing, as did 6 *Dendroica* species (from 1 to 8 individuals of each). With larger samples of 3 *Dendroica* species—16, 16, and 25 individuals—all but 4 birds scratched over the wing; but 1 Myrtle Warbler *(D. coronata),* 1 Blackpoll *(D. striata),* and 2 Bay-breasted Warblers *(D. castanea)* used both methods.

The 3 *Vermivora* species, however, all scratched under the wing: 1 Orange-crowned *(V. celata),* 7 Nashvilles *(V. ruficapilla)* and no less than 19 Tennessees *(V. peregrina).* The same was true of 2 Ovenbirds, 1 Yellow-breasted Chat *(Icteria virens),* and 2 Canada Warblers *(Wilsonia canadensis).* As to 4 examples of another species of this genus—Wilson's Warbler *(W. pusilla)*—one scratched over the wing, one under, and two used both methods.

Information has been kindly given us on 4 other warblers in the wild: the Prairie Warbler (*Dendroica discolor*) scratched over the wing (Val Nolan, Jr.), as did the Chestnut-sided (*D. pensylvanica*) and Yellow-throated *(D. dominica)* (I. C. T. Nisbet), but the Worm-eating



Head-scratching Movements. (*Above left*) Nashville Warbler, *Vermivora ruficapilla*. (*Above right*) Tennesese Warbler, *Vermivora peregrina*. (*Middle left*) Ruby-crowned Kinglet, *Regulus calendula*, No. 59209, scratching over the wing. (*Middle right*) Ruby-crowned Kinglet, same individual, scratching under the wing. (*Below left*) Slate-colored Junco, *Junco hyemalis*, No. 53642, scratching over the wing. (*Below right*) Slate-colored Junco, same individual, scratching under the wing. (Photos by W. E. Schantz.)

Warbler (*Helmitheros vermivorus*) scratched under the wing (I. C. T. Nisbet).

Thus striking variety in head scratching has been found in the family Parulidae: 12 species of 4 genera (*Dendroica, Geothlypis, Wilsonia, Setophaga*) have been seen scratching over the wing only; 7 species of 5 genera (*Helmitheros, Vermivora, Seiurus, Icteria, Wilsonia*) under the wing only, while 6 species of 3 genera (*Dendroica, Seiurus, Wilsonia*) have been watched carrying out both methods. Scratching over the wing has been reported in 5 genera, under the wing in six.

Diversity was also found among the 21 other species tested. Fifteen of them scratched consistently over the wing. The one Catbird (*Dumetella carolinensis*) scratched under the wing, doing so "several times." One Starling (*Sturnus vulgaris*) scratched over the wing; two used both ways. Four Common Grackles (*Quiscalus quiscula*) scratched over the wing, while one employed both techniques. Nine Ruby-crowned Kinglets (*Regulus calendula*) scratched over the wing, but one, as shown in the photographs, used both ways. Slate-colored Juncos (*Junco hyemalis*) proved to be the most successful of all the birds in employing both methods: 10 scratched over the wing, and one only under the wing, but 9 scratched both over and under. Under the wing was ordinarily used when the bird was particularly annoyed; it was commonly used on the ground, while over the wing was used on a perch. There was little evidence that position of the patch influenced the method of scratching.

Robert W. Ficken writes us that he has seen the Common Grackle scratch under the wing on two occasions. Ian C. T. Nisbet writes us he has observed the same in a recently fledged Brown-headed Cowbird (*Molothrus ater*): "it was a notably awkward affair," and the junior author has noted this method in three individual cowbirds, a nestling, a juvenile male, and an adult female.

Two observations on non-passerines should be mentioned. An Abyssinian Lovebird (*Agapornis taranta*) scratched under the wing as a nestling and occasionally when adult, although as a rule it scratched over the wing (W. C. Dilger, pers. obs.). A hand-raised Killdeer (*Charadrius vociferus*) scratched under the wing from his first day to the morning of the eighth; in the afternoon he switched to over the wing and continued in this manner thereafter (Nice, MSS.).

Thus some birds, both passerine and non-passerine, may scratch under the wing at first, then later over the wing. No instance of the reversed situation seems to have been reported.

Of the 19 individuals reported by the junior author as using both methods, 16 employed predominantly the typical passerine technique.

It is evident that on occasion a number of passerines are capable of using the direct method. With some of the Parulidae, however, scratching under the wing appears to be the habitual custom. This seems well established for the Ovenbird and for the Nashville and Tennessee Warblers. The junior author spent more time on the last species than on any other, for he tried his best to get an indication of over the wing scratching; he spent as much as 6 hours watching some individuals and even 18 hours on an especially cooperative bird. Members of this family offer a fruitful field for observation.

The observations of the Fickens, ourselves, and others, differ from Simmons' conclusions that: "Birds scratch in one only of two ways, either directly or indirectly, and one method is used by all members of the same family," (1957: 181). This character has proved less rigid than has been believed. It has been shown that some species may start scratching the head under the wing, then change to over the wing. Also there may be diversity in this movement within one family, one genus, one species, and even in one adult bird.

SUMMARY

Head-scratching movements in birds—whether under the wing or over the wing—are reviewed and additional cases reported.

Experiments in which head-scratching was induced by sticking a piece of gummed paper on the side of the head of birds captured for banding provided records for 40 passerine species. Much variety in method of head-scratching was found, especially among the 19 species of Parulidae tested.

The method of head-scratching proves to be less stereotyped than has been assumed. Diversity may exist within a family, a genus, or among individuals of the same species, and the same individual may use both methods.

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This article is dedicated to Erwin Stresemann on the occasion of his seventieth birthday.

DIFFERENTIAL RESPONSES OF MALE OVENBIRDS TO RECORDED SONGS OF NEIGHBORING AND MORE DISTANT INDIVIDUALS

BY JUDITH STENGER WEEDEN AND J. BRUCE FALLS

General observations indicate that song plays an important part in the establishment and maintenance of territory by many species of birds. The role of song in territorial behavior may be investigated experimentally by playing tape-recorded songs in the field. In the present study recorded songs were used to elicit aggressive responses from male Ovenbirds *(Seiurus aurocapillus)* occupying territories. Experiments were designed to study particularly reactions of birds to songs of neighboring and more distant individuals of their own species.

These studies were carried out at the Wildlife Research Station of the Ontario Department of Lands and Forests in Algonquin Park during the summers of 1955 and 1956. A description of the study area and a detailed account of the nature and extent of Ovenbird territories is presented elsewhere (Stenger and Falls, 1959).

Behavior Observed in Natural Encounters Between Male Ovenbirds

In this paper reactions of male Ovenbirds to tape-recorded songs are interpreted in the light of behavior observed when territory-holders encountered intruding males. In such natural encounters chasing and vocalizing were noted frequently, threat display (similar to that described by Freeman, 1950) less often, and physical contact very rarely. Encounters were prolonged and vigorous when boundaries of territories were being established before the arrival of the females but decreased rapidly in duration and intensity as the breeding cycle progressed. During the nestling period and after the young left the nests a few call notes from a territory-holder were sufficient to drive an intruder away.

All the experiments were carried out after the females arrived and most of them after incubation had begun, *i.e.,* after the vigorous encounters between males associated with the establishment of territory were over.

Since vocalizing played an important part in natural encounters as well as in reactions of birds to tape-recorded songs, various sounds given by male Ovenbirds are listed below:

Song. The most frequent song and the one usually heard in encounters is one in which a phrase suggesting the word "teacher" is repeated about ten times at regular intervals, the whole song lasting about three seconds. Songs of individual

birds differ in pitch, speed, and details of the phrases but each individual's song is constant. Thus, an experienced person can separate most individuals by their distinctive songs. Only the males sing. Recordings of "teacher" songs of several birds were used in the experiments.

Warbling. Warbling sounds with or without "teacher" phrases interspersed were heard on a number of occasions, usually at the end of an encounter. These sounds were given from a stationary position but resembled the so-called "flight song" (Bent, 1953).

Call notes. Three types of chipping sounds given by males can be readily distinguished.

A sharp, high-pitched note is elicited by the sudden appearance of another Ovenbird or when a bird is disturbed by humans.

A lower-pitched "chuck", usually given four or five times at intervals of a second or more, often occurs at the end of an encounter.

Rapid call notes, similar in pitch to the "chuck" notes but repeated at intervals of less than one second, are given during encounters with other birds or when birds are disturbed by humans.

EXPERIMENTAL STUDIES

In this study recorded "teacher" songs were played through loudspeakers located within the territories of several Ovenbirds. Reactions of these birds were studied with special reference to differences in responses elicited by songs of Ovenbirds occupying adjacent territories on the one hand, and songs of non-adjacent birds on the other hand.

Adjacent birds were those which occupied neighboring territories not separated by any topographical features. Their territorial boundaries overlapped or were separated by distances up to 70 feet (Stenger and Falls, 1959). Distances between "centres of gravity" (calculated by the method of Odum and Kuenzler, 1955) of neighboring territories ranged from 160 to 440 feet with an average of 325 feet (data from 23 experiments). Six territories in the study area averaged 2.3 acres in extent.

Non-adjacent birds, on the other hand, were those separated by at least one intervening territory or by some topographic feature such as a hill or a large clearing. Distances between territories (centres calculated as above) of non-adjacent birds and territories of birds to which their songs were played ranged from 405 feet to more than a mile and a half.

It is difficult to determine how far away one Ovenbird can hear another. During the period when the experiments were done birds sometimes seemed to react to natural songs heard near their territories but no evidence was obtained about reactions to distant songs. Under favorable conditions in the study area an experienced person might hear an Ovenbird 1000 feet away and could distinguish songs of some individuals at half that distance. If we may judge from these rough

estimates based on human experience, there is little doubt that under natural conditions a bird could easily hear the songs of its neighbors and might hear the songs of the closer non-adjacent birds. However, it is unlikely that the birds tested in these experiments had previously heard the songs of the more distant non-adjacent birds which were played to them.

The equipment used in the experiments covered the frequency range of an Ovenbird's song (about 3,000 to 8,000 cycles per second) and the reproduced songs sounded normal to the experimenters, although more directional than the song of a bird. Thus, reproduced songs were usually louder than normal songs if heard directly in front of the speaker, but were not as loud to the side or behind the speaker. Details of equipment follow:

Songs were recorded with an Electro-voice 635 microphone mounted at the focus of a 30-inch parabolic reflector. In 1955 a Webcor 210 tape-recorder was used at a tape speed of 7½ inches per second. In 1956 an Ampex 600 recorder was used at 15 inches per second. For play-back, a good quality four-watt amplifier was used with the recorder. Loud-speakers were used on cables up to 500 feet long. In 1955 eight-inch cone speakers were used mounted in plywood boxes, and in 1956 Atlas HR-2 metal "tweeters" were used unmounted.

Two types of experiments were carried out and will be referred to respectively as "intensive" and "extensive" experiments. Intensive experiments were done with a few birds in one area with each bird tested many times. Extensive experiments, on the other hand, involved more birds in four widely-separated areas with each bird tested only a few times. Methods and results for the intensive experiments will be given first, followed by those for the extensive experiments.

"Intensive" studies were made of the birds occupying a surveyed plot of about 25 acres on which territorial boundaries were accurately known. Preliminary experiments were done on eight birds from June 17 to July 21, 1955 and a more extended series of experiments was carried out on five birds from May 29 to July 12, 1956. Six of the eight birds used in 1955 and all six birds used in 1956 were tested with songs of both adjacent and non-adjacent birds. Non-adjacent birds were located from 405 feet to more than one and a half miles from the birds tested.

In 1955 the following procedure was used. A loud-speaker was placed on or near the ground at a standard location within a territory. Songs given by the resident male were counted for five minutes before recordings were played. Then recorded songs of one bird were played for four minutes with natural intervals between songs (variable, but averaging about 15 seconds). This was followed by five minutes of silence during which the speaker was moved 132 feet to a new location, still within the territory. The same songs were played again for a final period of four minutes from the new location. During the whole experiment, the number of songs and types of call notes given

by the territory-holder and the number of locations which it visited were noted. Successive experiments on the same bird were separated by at least two hours.

In 1956 some changes in procedure were adopted. A speaker was hung in a tree 20 to 30 feet above the ground (a height at which Ovenbirds normally sing) and only one location was used in each territory. A recorded song was played at regular 15-second intervals (using a loop of tape) for three minutes, followed by three minutes of silence and a final three minutes of playing. The observer hid beneath a blind during the experiments. No bird was tested oftener than every two days.

In analyzing the results of these experiments four responses by a bird were considered—song, call notes, approach to the speaker, and amount of movement in the vicinity of the speaker. A bird was considered to have responded with respect to each category as follows:

Song—If the number of songs per unit of time was greater during the experiment than before and if singing continued after the experiment.

Call notes—If at least two types were given.

Approach—If a bird approached within 30 feet of the speaker.

Movements—If a bird visited more than five locations in the vicinity of the speaker.

Responses of birds to songs of adjacent and non-adjacent individuals are summarized in Table 1. A bird might react to the tape-recorded songs with respect to one, two, three, or four of the foregoing behavior categories, or not at all. The results show that, for the most part, birds reacted in three or four ways to songs of non-adjacent birds, but failed to react, or reacted in only one or two ways, to songs of neighboring birds.

Responses usually included approach and call notes, but most birds showed idiosyncracies of some sort in their reactions. For example, one bird was unusual in that it reacted mainly by singing; another usually performed threat displays; a third usually gave warbling songs.

The "extensive" experiments, it will be recalled, were designed to obtain quantitative data on a larger sample of birds than was possible in the "intensive" experiments, and to minimize the amount of recorded song played in any one area. In these experiments about one-tenth as many songs were played in any one area as in the intensive experiments already described. Fourteen birds in four widely separated areas were studied from June 14 to July 20, 1956. Non-

TABLE 1

NUMBER OF EXPERIMENTS CLASSIFIED BY RESPONSE OBTAINED TO SONGS OF ADJACENT AND NON-ADJACENT BIRDS

	Four categories of response noted	*Three categories of response noted*	*Two categories of response noted*	*One category of response noted*	*No response noted*
1955					
Response to adjacent birds	0	1	4	1	0
Response to non-adj. birds	20	4	0	1	0
1956					
Response to adjacent birds	2	1	4	5	5
Response to non-adj. birds	10	7	5	1	0
Totals					
Response to adjacent birds	2	2	8	6	5
Response to non-adj. birds	30	11	5	2	0

adjacent birds whose songs were used were from a third of a mile to one and a half miles away from the birds tested. It is unlikely, therefore, that the tested birds had heard these songs before.

In these experiments the loud-speaker was placed at one location in each territory about six feet above ground. A song was played every 15 seconds until the territory-holder approached the speaker. A minimum of four songs was played. If the bird did not approach, the test song was played for three minutes followed by three minutes of silence and a final three-minute period of playing. Songs of the territory-holder were counted before, during, and after each experiment. The times which elapsed from the playing of the first song until the bird first reacted by sound and approach were noted to the nearest 15 seconds. Five experiments were performed on each bird, usually at least two days apart, and a different test song was used on each occasion. In the course of these experiments, each bird was exposed to songs of two non-adjacent birds and two adjacent birds, and to its own song. The order in which these songs were used and the order in which birds were tested each day were random.

Results are shown in Tables 2 and 3. In Table 2, time values of zero are given for reactions which occurred between the first and second playings of the recorded song (*i.e.*, in the first 15 seconds),

values of 15 for reactions between the second and third playings and so on. This procedure was adopted because vocal responses usually occurred immediately after a recorded song was played. No results are shown for experiments in which technical failures occurred or the identity of the reacting individual was not established. Only average values for time of approach are given in Table 2 since the detailed data are similar to those presented in the same table for time of the first sound.

It is apparent from Tables 2 and 3 that birds reacted more quickly (by sound and approach) and more strongly (*i.e.*, sang more) to songs of non-adjacent birds than to songs of their neighbors, the differences being statistically significant. Responses of birds to their own songs were intermediate in these respects.

Birds typically responded by uttering call notes and approaching the loud-speaker. On 44 of 66 occasions when responses occurred, the

TABLE 2

TIME ELAPSED BETWEEN FIRST RECORDED SONG AND BIRD'S REACTION

		Recorded songs used				
		Adjacent		*Non-adjacent*		*Bird's*
		No. 1	*No. 2*	*No. 1*	*No. 2*	*own*
First sound by bird						
Area	***Bird***					
A	1	0 sec.	60 sec.	0 sec.	0 sec.	0 sec.
A	2	180	120	75	30	60
A	3	0	75	0	0	360
A	4	75	0	0	15	NR
B	1	15	15	0	0	15
B	2	105	495	45	420	0
C	1	0	—	0	0	120
C	2	30	—	0	15	30
C	3	—	15	0	—	NR
C	4	0	60	0	30	NR
D	1	—	—	15	0	30
D	2	0	45	15	0	0
D	3	0	15	0	0	0
D	4	NR	15	15	90	15
Average		60 sec.		28 sec.		57 sec.
Probability of chance difference*		$P < .01$				
First approach noted						
Average		74 sec.		45 sec.		64 sec.
Probability of chance difference*		$P < .05$				

* "t" test pairing data for adjacent and non-adjacent experiments for each bird. NR indicates no reaction.

TABLE 3

SONGS GIVEN BY BIRD IN FIVE MINUTES FOLLOWING EXPERIMENT MINUS SONGS GIVEN IN FIVE MINUTES BEFORE EXPERIMENT

		Recorded songs used				
		Adjacent		*Non-adjacent*		*Bird's*
Area	*Bird*	*No. 1*	*No. 2*	*No. 1*	*No. 2*	*own*
A	1	10	12	26	31	30
A	2	0	12	11	4	7
A	3	−6	26	8	21	17
A	4	20	0	—	9	NB
B	1	17	16	—	23	22
B	2	9	1	7	8	−1
C	1	12	—	22	26	23
C	2	—	—	11	3	19
C	3	—	3	30	—	0
C	4	7	1	−2	—	NB
D	1	—	—	27	37	12
D	2	8	7	23	2	18
D	3	18	9	10	14	10
D	4	−1	22	—	26	6
Average		9.2 songs		16.4 songs		13.6 songs
Probability of chance difference*		$P < .05$				

* "t" test pairing data for adjacent and non-adjacent experiments for each bird. NB indicates no bird in evidence.

first sounds given were call notes. Most birds eventually sang near the speaker but they often did not sing until the playing of recorded songs was stopped. As in the intensive experiments, marked differences were noted in the way individual birds reacted. Compare, for example, the considerable times taken for birds A2 and B2 to react with the much shorter times for birds A1 and D3 (Table 2).

In both intensive and extensive experiments there was considerable variation in the responses of the same birds on different occasions. Many factors may have contributed to this variability including weather (wind, rain, etc.), stage of the breeding cycle when a bird was tested, and minor variations in technique (for example, loudness at which recorded songs were played).

DISCUSSION AND CONCLUSIONS

In both intensive and extensive experiments birds behaved in much the same way as those observed in natural encounters with other males. In each case approach, movements, songs, call notes, and threat displays were noted. It is reasonable to suppose, then, that the findings of the experiments also apply to natural encounters between birds.

Certain conclusions may be drawn from the results of these experi-

ments. Obviously, song is a sufficient stimulus to elicit an aggressive response from a male Ovenbird, provided it originates within his territory. It is also clear that sounds, particularly call notes, play an important part in the aggressive behavior by which the territory is defended. Apparently, Ovenbirds can distinguish between songs of different individuals of their species and can recognize songs of particular individuals (their neighbors). Moreover, they react more strongly to songs of non-adjacent birds than to songs of their neighbors.

Individual Ovenbirds have constant and distinctive songs. It is not surprising, therefore, that a bird learns to recognize the songs of others which it hears frequently. As Hartshorne (1956) points out, what stimulates animals is change; what deadens response is sameness or persistent repetition. The weak reactions to songs of neighbors noted in these experiments may be an example of a response which has been reduced in intensity by a persistent repetition of the stimulus.

Early in the season, before most of these experiments were done, boundaries of territories are established as a result of encounters between neighboring males. The social adjustment between the birds which results from these experiences may be another factor which tends to reduce the aggressive response of a bird to the songs of its neighbors.

Whatever the factors which bring about the observed differences in response to songs of the non-adjacent and adjacent birds, there would appear to be survival value in a mechanism which reduces strife once territorial boundaries are established. Later in the breeding season, when most of these experiments were carried out, the chief danger of serious encroachment on a bird's territory would presumably come from strangers and it is appropriate that they should elicit a strong aggressive response on the part of a territory-holder.

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SUMMARY

Encounters between male Ovenbirds in the breeding season consisted of vocalizing (songs and call notes), chasing, threat displays, and rarely physical contact. Encounters were prolonged and highly aggressive before the arrival of females, and became briefer and less intense as the breeding season progressed.

When tape-recorded Ovenbird songs were played through a speaker located within an Ovenbird's territory, the territory-holder reacted in much the same way as in a natural encounter with another male.

Birds reacted faster and more strongly to songs of non-adjacent birds than to songs of their neighbors. Probable causes and survival value of this behavior are discussed.

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STOMACH CONTENTS

About 20,000 specimens of bird and mammal stomach contents remaining in the Patuxent Research Refuge Food Habits Collection of the Fish and Wildlife Service have been transferred to the Department of Zoology, University of Massachusetts. The specimens will be available after February, 1960, to qualified research personnel for food habits studies. Address inquiries to Dr. L. M. Bartlett, Associate Professor of Zoology, University of Massachusetts, Amherst, Massachusetts.

ADDITIONAL INVERTEBRATE NEST ASSOCIATES OF THE PRAIRIE WARBLER

BY VAL NOLAN JR.

In an earlier report on invertebrates collected from nests of the Prairie Warbler *(Dendroica discolor)* near Bloomington, Indiana, one snail, seven species of mites, and at least 12 species of insects were recorded from nine nests (Nolan, 1955). The present paper summarizes data from 14 additional nests of the same warbler. The study area and method of collection were virtually identical with those described previously, although collection from four of the nests was accomplished by visual inspection and by hand instead of by the Berlese funnel. One snail, at least two species of spiders, four species of mites, and at least 25 species of insects were found. Of the ten nests placed in funnels, only three yielded more than three species; two nests harbored six invertebrates each and one contained ten. This last held a young Brown-headed Cowbird *(Molothrus ater);* it was the only nest, among those subjected to the Berlese process, parasitized by that bird.

Animals common to the earlier and the present lists numbered only about seven, a statement whose vagueness is attributable to the impossibility of precise determination in some cases. No Mallophaga appear on either list.

I am grateful to J. F. Gates Clarke and O. L. Cartwright of the Smithsonian Institution for referring the material to the specialists indicated; my indebtedness to the members of this latter group is manifest.

The nests. Of the following nests, numbers 4, 10, 11, and 14 were not placed in Berlese funnels, and collection was thus limited to larger, conspicuous animals. The proportion of successful nests on the list is very much higher than it would be in a random sample. Plant names follow Deam (1940).

1. Nest 3 feet 8 inches high in 10-foot sugar maple *(Acer saccharum).* Destroyed by predator May 27, 1953, during incubation.

2. Nest 6 feet 10 inches high in 10-foot white elm *(Ulmus americana).* Young left nest May 28, 1954.

3. Nest 4 feet 2 inches high in 18-foot sugar maple. Nestlings removed by predator June 3, 1953.

4. Nest 6 feet 2 inches high in 10-foot white elm covered by Virginia creeper *(Parthenocissus quinquefolia).* Young left nest June 9, 1954.

5. Nest 1 foot 10 inches high in 4-foot blackberry (*Rubus* sp.). Nestlings removed by predator June 11, 1953.

6. Nest 4 feet 10 inches high in 8-foot sugar maple. Warbler nestlings died as result of presence of young Brown-headed Cowbird, which left nest June 12, 1953.

7. Nest 9 feet high in 16-foot white elm. Young left nest June 13, 1954.

8. Nest 11 feet 2 inches high in 16-foot apple *(Malus pumila)* covered with Virginia creeper. Young left nest June 14, 1953.

9. Nest 9 feet high in 13-foot elm covered with Virginia creeper. Young left nest June 17, 1953.

10. Nest 15 inches high in 2½-foot blackberry. Young left nest June 21, 1954.

11. Nest 14 feet high in 19-foot black locust *(Robinia pseudo-acacia)* covered with Japanese honeysuckle *(Lonicera japonica)*. Two eight-day-old Prairie Warblers and one cowbird of same age removed by investigator on June 26, 1958.

12. Nest 8 feet 10 inches high in 15-foot white elm. Young left nest July 9, 1954.

13. Nest 4½ feet high in 10-foot white elm. Young left nest July 17, 1953.

14. Nest 2½ feet high in 5-foot white elm. Two of three eggs hatched July 11, 1958, and one egg hatched July 12. One of older nestlings removed by investigator on July 15. Youngest nestling grew progressively weaker and died on July 17; remaining bird left nest July 21.

The invertebrates. Information concerning classification and food habits of the following animals was taken from Pilsbry (1948), Baker and Wharton (1952), Kaston and Kaston (1953), Imms (1957), Borror and DeLong (1954), and Comstock (1949).

GASTROPODA

PULMONATA (SNAILS)

Pupillidae, determined by J. P. E. Morrison: *Pupoides albilabris* (C. B. Adams). One in nest 10. Probably casual; ordinarily terrestrial, a scavenger on plant and animal material.

Whether this species and *Gastrocopta armifera* (previously reported) were picked up by the warblers or were carried to the nests as they clung to bits of plant fiber, or whether they climbed up under their own power, it is clear that this is another instance in which a bird may become an agent in dispersing small mollusks. Roscoe (1955) tells of the discovery of aquatic snails on birds' plumage, and Ramsden (1914), McAtee (1914), and Paton and Williamson (1943) refer to similar episodes involving terrestrial snails.

ARACHNIDA

ARANEIDA (SPIDERS)

Salticidae, determined by R. A. Crabill: (1) *Paraphidippus* probably *marginatus* (Walck.). One in nest 10. Probably foraging, casual. (2) *Synemosyna lunata* (Walck.) One in nest 6. Probably foraging, casual.

Spider damaged too extensively to permit certain allocation to family. One in nest 7. Probably foraging, casual.

ACARINA (MITES), determined by E. W. Baker

Dermanyssidae: *Ornithonyssus sylviarum* (Canestrini and Fanzago). One in nest 5, at least 1000 in nest 6, about 100 in nest 9, at least 250 in nest 13. Parasitic on the birds.

In view of the fact that Western equine encephalomyelitis virus and St. Louis encephalitis virus have been recovered from northern fowl mites *(Ornithonyssus sylviarum)* collected from bird nests (Reeves et al., 1947; Hammon et al., 1948),

data on this species may assume considerable significance. The most interesting point would seem to be the contrast between 1953 and the other years of the study, i.e., 1952 and 1954-1958. A few northern fowl mites were funneled out in 1952 (reported under the name *Bdellonyssus sylviarum*, Nolan, 1955), and some may be assumed to have been present in later seasons. Numbers of any that may have occurred in the six years other than 1953 were so small, however, that visual inspection, and in many cases handling, of over 200 Prairie Warbler nests and some 200 nests of other species on the study area revealed no mite infestation at all. In 1953, on the other hand, nests 6, 9, and 13 were teeming with numbers greatly exceeding the quantities actually collected, and at least three additional Prairie Warbler nests were so infested that swarms of mites covered my hands as soon as I touched the structures. These latter animals were not collected, but they may have been *Ornithonyssus*. Of the nests in which they were found, two were emptied of their nestlings by predators, on July 23 and July 25, 1953; young left the other nest successfully on July 18.

No mites have been noticed on hundreds of live nestling Prairie Warblers handled since 1952 or on about 80 adults banded since 1955. Russell Mumford and I have removed a number of still undetermined parasites from the bodies of about 100 Prairie Warblers killed in 1957 and 1958 at a television tower in Leon County, Florida, during nocturnal migration; *Ornithonyssus* may be among the animals gathered from these birds, but if so there were no conspicuous numbers.

Anystidae: *Anystis* sp. One in nest 6. Predaceous on other mites and small insects.

Cheyletidae: *Cheyletia* sp. One each in nests 2 and 12. Some cheyletids are parasitic on bird feathers; others are predaceous on mites and insects.

Analgeroidea: More precise determination impossible. One nymph in nest 1. Probably a feather mite.

INSECTA

COLLEMBOLA (SPRINGTAILS)

Not determined. Five in nest 6. Scavengers or feeders on micro-organisms.

CORRODENTIA (PSOCIDS)

Liposcelidae, determined by K. M. Sommerman: (1) *Liposcelis* sp. subgenus A. Three in nest 6, 5 in nest 7, 1 in nest 9, 1 in nest 12. Scavengers on animal and plant material. (2) *Liposcelis* sp. subgenus B. Four in nest 7. Scavengers on animal and plant material.

THYSANOPTERA (THRIPS)

Thripidae, determined by Kellie O'Neill: (1) *Frankliniella tritici* (Fitch). One female in nest 7. Plant feeder. (2) *Limothrips* sp. One female in nest 2. Either a predator on small arthropods, or a plant feeder.

Phlaeothripidae, determined by Kellie O'Neill: (1) *Leptothrips* sp. One adult in nest 7. Predator or spore or plant feeder. (2) Probably *Karnyothrips* sp. One male and 1 female in nest 5. Predator, or sport or plant feeder.

HOMOPTERA

Cicadellidae (leafhoppers), determined by J. P. Kramer: *Empoasca fabae* (Harris). Two males in nest 5. Plant feeder, casual.

Fulgoroidea (planthoppers), determined by J. P. Kramer: *Scolops sulcipes* Say. One female in nest 12. Plant feeder, casual.

Aphididae (plant lice), determined by Louise M. Russell: Aphidinae, genus and species not determinable. One early instar nymph in nest 6. Plant feeder, casual.

Coccoidea, determined by H. Morrison: Coccinae (cochineal insects). One larva in nest 6. Plant feeder, casual.

COLEOPTERA (BEETLES)

Dermestidae, determined by R. S. Beal: *Trogoderma* probably *glabrum* (Herbst). One skin cast in nest 8. Scavenger on animal material.

Lathridiidae, determined by J. G. Rozen: Genus and species not determinable. Four larvae in nest 5. Feeder on fungi and Mycetozoa, in vegetable debris; some found in mammal nests.

LEPIDOPTERA (BUTTERFLIES AND MOTHS)

Gelechioidea, determined by H. W. Capps: Stages too early for further determination. Five in nest 5. Feed as larvae on living and dead plant material.

Tineidae, determined by H. W. Capps: Stages too early for further determination. Ten in nest 1, 14 in nest 6, 30 in nest 9. Scavenger on dead or decayed animal and plant material.

DIPTERA (FLIES)

Psychodidae, determined by A. Stone: *Psychoda alternata* Say. One in nest 3. Scavenger on decaying organic material, possibly a coprophage.

Heleidae, determined by W. W. Wirth: *Culicoides* sp. Fourteen in nest 7. Larvae occur in wet and moist situations, e.g., decaying vegetation; may scavenge. Adults are blood suckers.

Lycoriidae, determined by A. Stone: *Bradysia* sp. One in nest 1. Fungus feeders as larvae.

Itonididae, determined by R. H. Foote: Damaged too extensively for further determination. One in nest 5. Larval food habits vary greatly; perhaps a scavenger.

Calliphoridae, determined by C. W. Sabrosky: (1) *Protocalliphora metallica* (Tns.). Twenty larvae in nest 11, 23 larvae in nest 14. Parasitic; larvae suck blood of nestling birds. (2) *Protocalliphora* new species, presently being described in revision of the genus. Several in nest 4. Parasitic; larvae suck blood of nestling birds.

Five of the 23 nests reported in this and my 1955 paper held *Protocalliphora* larvae and at least 15 or 20 additional nests of the Prairie Warbler have been dismantled in an unsuccessful search for these maggots. On the subjects of the habits of these parasites and their effects on the nestlings I would add to my previous remarks the following observations: On June 24, 1952, four maggots, not collected but probably *Protocalliphora*, were found at mid-day apparently feeding on the exposed viscera of a young bird recently killed by a predator and left in the nest. In 1958, the young Brown-headed Cowbird in nest 11 was distinctly less vigorous than experience with young of that species would have led me to expect, and this may have been true of one of its nest-mate warblers; the cowbird died some four hours after I had removed it from the nest. Further evidence that the maggots

lower the vitality of nestlings is the fact that the last bird to hatch in nest 14 failed to gain weight properly and died on its sixth day. On the other hand, this death left only one young bird in nest 14 as a potential host for the 23 maggots; yet that bird seemed normally vigorous and departed from the nest at the usual age.

HYMENOPTERA

Scelionidae (scelionid wasps), determined by C. F. W. Muesebeck: *Trichasius* sp. One male in nest 6. Parasitic in insect or spider eggs.

Formicidae (ants), determined by M. R. Smith: (1) *Solenopsis molesta* (Say). Several workers in nest 13. Probably scavenging or casual. (2) *Crematogaster lineolata* (Say). At least 1 worker in nest 13. Probably foraging, casual. (3) *Lasius neoniger* Emery. One worker (infected with parasitic fungus *Laboulbenia* sp.) in nest 6, 2 workers in nest 10. Probably foraging, casual.

There is a general discussion of the fauna of birds' nests in chapter 14 of Rothschild and Clay's (1952) work on bird parasites. Boyd (1951) has reviewed the ectoparasites of birds, while Herman (1955) recently surveyed the literature on that subject. Hicks (1959) has published a check-list of insects found in birds' nests.

SUMMARY

The invertebrates found in fourteen nests of Prairie Warblers (*Dendroica discolor*) near Bloomington, Indiana are listed. One species of snail, at least two of spiders, four of mites, and at least 25 of insects were found.

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Indiana University, Bloomington, Indiana.

ERRATUM

'The Auk,' **79** (2), pp. 133, 138, April, 1959. Dr. K. C. Parkes sends a useful correction. The Piping Plover reported banded at "Penn Yan," New York and recovered at Long Beach, Ontario, "about 150 miles west" of where it was hatched, was actually banded at "Sandy Pond, Oswego County," (a bay of Lake Ontario), "about 250 miles southwest" of the recovery site. The error was in the records of the Fish and Wildlife Service, which, on checking, found that the bander's residence (rather than the banding site) had been listed.

INFORMATION ON COLOR PHASES

D. F. Owen, Dept. of Zoology, University of Michigan, Ann Arbor, Michigan, is investigating the possibility of preferential, non-random mating between animals having distinct color phases. He would like to receive records of the color of known breeding pairs of polymorphic birds, particularly the Screech Owl (*Otus asio*), Ferruginous Hawk (*Buteo regalis*), and the western race of the Red-tailed Hawk (*Buteo jamaicensis calurus*). Data on color is of interest whether the members of the breeding pair were the same or different in coloration.

GENERAL NOTES

Earlier Photographic Records of the Common Crane *(Grus grus)* for North America—in Alberta, Canada.—The Common or Gray Crane (*Grus grus*) has been sighted and photographed in Alberta twice previous to, and once since, the Alaska observation, reported as the first for North America (Kessel and Kelley, Auk, **75**: 465, 1958). On December 11, 1957 Fred Sharp observed a Common Crane frequenting a farm one mile northwest of Cavendish, Alberta. The crane fed in a wheat field each morning for about three weeks before departing on December 20. Sharp was able to take snapshots (Plate 13) and some fifty feet of 16 mm. movie film of the crane both in flight and on the ground. The literature locally available did not permit positive identification at that time. On March 20, 1958 the Common Crane was sighted again by Mr. E. Carr near the Stirling Lake area south of Lethbridge, Alberta, and the bird was photographed by the "Lethbridge Herald" photographer. Both photographic records were forwarded to Mr. K. C. Lint, Curator of Birds at the San Diego Zoological Gardens in California. He considered the bird probably *Grus grus lilfordi* and thought that it must have escaped from a private breeder or zoological garden. On April 24, 1958 the Alaska observation was made. On September 19, 1958 William Wishart observed and photographed a Common Crane with two Sandhill Cranes (*Grues canadensis*), feeding in a clover field five miles southeast of Athabasca, Alberta. (An identifiable print was sent to the editor of "The Auk".) The cranes rested in a slough for about an hour after feeding, took flight, and when last seen were headed southward.

It is interesting to note that the pattern of observations so far tend to follow the migration route of the Sandhill Crane. Some of the latter are known to inhabit northeastern Siberia, where an overlap of ranges with the eastern race of the Common Crane (*G. g. lilfordi*) might occur. The possibility exists that at least one Common Crane has been taking the North American route. WILLIAM WISHART, *Fish and Wildlife Division, Department of Lands and Forests, Edmonton, Alberta,* FRED SHARP, *Provincial Naturalist, Ducks Unlimited, Tilley, Alberta.*

Nesting of the Lesser Swallow-tailed Swift, *Panyptila cayennensis*, in Guatemala.—Although the Lesser Swallow-tailed Swift has been taken in most of the Central American republics, the small population which has been reported in the lowlands of southeastern Mexico (southern Veracruz) was thought to be separated from the more southern populations by a great expanse of territory in southeastern Mexico, all of Guatemala and western Honduras. That *P. cayennensis* does occur within this assumed gap was demonstrated when the writer, accompanied by his wife and Miss Katrina Thompson of Houston, found an occupied nest of this swift on the side of a tree which grew on the steep bank sloping upward at the south edge of the Great Plaza in Tikal (altitude about 500 ft.), in the Peten region of Guatemala. This was on the morning of June 9, 1958, when I saw a single individual enter the nest. Within the next five minutes two individuals emerged from the nest, at an interval of a minute or two, and flew rapidly away. The nest, attached along its entire length to the tree-trunk, seemed to be similar to several which have been previously described for this species, being a long vertical tube constructed of the down associated with the seeds of some tropical plant. The tube was judged to be less than four inches in diameter at its thickest point, was about 20 inches long, and was placed approximately 20 feet above the base of the tree. (Plate 13, *below*.)

(*Above*) COMMON CRANE (*Grus grus*) near Cavendish, Alberta, December, 1957. (Photo. by Fred Sharp.)

(*Below*) NEST OF LESSER SWALLOW-TAILED SWIFT (*Panyptila cayennensis*), Tikal, Guatemala. June 9, 1958. (Photo. by Ernest P. Edwards.)

On the following day we saw two individuals flying high above the archaeological site in company with *Chaetura vauxi*. A little later one of the *P. cayennensis* broke away from the small group and dived swiftly toward the nest, but was lost to view when it reached tree-top level. A few moments later, with the nest again in sight, I saw what was doubtless the same bird drop head first out of the nest and fly rapidly away. Four times I saw a bird leave the nest and each time it followed the same general path, climbing gradually as it flew swiftly through the partially open cut where the road led into the forest toward the east. Twice when I saw an individual entering the nest it swept up from below with great speed, and went in with scarcely a pause, once affording a fleeting glimpse of the wings still outstretched when the bird was within a few inches of the nest. At that moment the wingspread was seen to be considerably less than the 12-inch diameter of the nest tree.

It is of interest to note that one week after finding the nest of *P. cayennensis* at Tikal we saw three individuals of the very similar, but much larger, Great Swallow-tailed Swift, *P. sancti-hieronymi*, in the vicinity of a canyon northeast of Guatemala City, at about 4,500 ft. elevation, at the 15 kilometer mark on the highway to Puerto Barrios.—Ernest P. Edwards, *Museum of Natural History of Houston, Box 8175, Houston 4, Texas.*

Cattle Egret in Haiti.—On June 21, 1956, while driving north along the length of Highway #112 in the Department de L'Artibonite, Haiti, the writer, accompanied by his wife, estimated that more than 100 Cattle Egrets (*Bubulcus ibis*) were observed. Similar numbers were seen the following day during the trip south along the same route. The egrets were scattered among herds of grazing cattle. Individuals with the lores, proximal two-thirds or so of the mandibles, and the legs red, apparently breeding birds, were distinguished clearly. At that time Highway #112 extended for 20 kilometers, originating and terminating at Highway #100. The route passed through low, partly irrigated country, a considerable portion of which was then given over to cattle grazing. On June 24, 1956, small numbers of Cattle Egrets were found along the north shore of Etang Trou Caiman in the Department de L'Ouest. Several were observed standing on the backs of goats. A non-breeding male bird was collected in this area. The skin is now in the University of Miami Reference Collection.

Bond, in the First Supplement (1956: 2) to the "Check-List of Birds of West Indies" (1956), recorded a flock of Cattle Egrets seen in the Dominican Republic in January 1956, but does not mention any record from Haiti. The specimen is apparently the first to be collected on Hispaniola.

Several Haitian residents, familiar with the local birds, expressed surprise at learning that the Cattle Egret was resident in Haiti. It is of interest to document the spread of this recent invader from the Old World.—Oscar T. Owre, *University of Miami, Coral Gables 46, Florida.*

Cattle Egret (*Bubulcus ibis*) on Cozumel Island, Quintana Roo, Mexico.—On January 8, 1959, while visiting Cozumel Island, off the northeast coast of the Yucatan Peninsula, I saw, about 15 miles south of San Miguel, a Cattle Egret feeding on the ground a few inches ahead of a grazing horse. The bird seemed unusually fearless and permitted an approach to within about three yards, so that I was able to see a faint trace of buff on the top of the head. A local treasure hunter, who had previously told me about the bird, said that he had

frequently seen it perched on the horse's back. I am familiar with this species, having observed great numbers in Spain, Florida, and Puerto Rico.

The only previous Mexican report of the Cattle Egret appears to be the recovery on the mainland of the Yucatan Peninsula at Laguna Om, near Chetumal, Quintana Roo, on December 16, 1956, of a bird banded as a nestling at Lake Okeechobee, Florida, on June 10, 1956 (F. J. Ligas, Fla. Nat., 31: 25, 1958).

Paynter's invaluable "Ornithogeography of the Yucatán Peninsula" (Peabody Mus. Bull. 9: 36, 1955) includes no records for this heron, and states that on the Yucatan Peninsula the Common (American) Egret (*Casmerodius albus*) is less common than the Snowy Egret (*Leucophoyx thula*). During my three weeks stay on this peninsula, December 23, 1958 to January 10, 1959, I observed many egrets in parties of from three to eight, around the mangroves between Progreso and Sisal, up the Champoton River, in a marsh between Campeche and Champoton, on the ocean front at the town of Campeche, and along the west coast of Cozumel Island. With the exception of two Snowy Egrets and the Cattle Egret mentioned, all the remainder appeared to be Common Egrets.—REGINALD DENHAM, *100 Central Park South, New York 19, N. Y.*

The Wing Molt and Systematic Position of the Genus *Gampsonyx*.—In a recent paper (J. f. Orn., **99**: 81–88, 1958) I reported on my studies of primary molt of Falconidae. They yielded the result that all birds of prey which Sushkin (1905), for osteological reasons, had included in his family Falconidae (as opposed to his Accipitridae), had in common a peculiar mode of molting the primaries. In opposition to all the rest of his order Accipitriformes (Falconiformes), the Falconidae (in the sense of Sushkin) start by dropping the fourth primary (from within). Groups studied showing the *Falco* type molt were *Herpetotheres, Micrastur, Microhierax, Polihierax* (including *Neohierax*), and all the "caracara" genera: *Polyborus* (*Caracara*), *Milvago, Daptrius, Ibycter, Phalcobaenus.*

Inadvertently I also mentioned the neotropical *Gampsonyx* (Pearl Kite) among the genera belonging to Sushkin's Falconidae. I had been misled by consulting Peters' "Check List of Birds," vol. I, p. 281, 1931. Not Sushkin, but Peters had removed *Gampsonyx* from the kites (*Elanus, etc.*) and had placed it among the Falconidae near *Polihierax* and *Spiziapteryx*—a treatment adopted also by Hellmayr and Conover (Field Mus. Nat. Hist. Zool. Ser., 13, pt. 1, no. 4: 288–289, 1949).

Having at that time at my disposal only five skins of *Gampsonyx swainsoni* in primary molt, of which only three were in a significant molting stage, I fell a victim to the impossibility of telling positively the age of the three innermost primaries. I ventured to rank them among the "old" feathers in specimens 1, 2, 3 of my list (*op. cit.*: 86). They belong, however, in the category of recently molted primaries. This became apparent when I examined 29 molting *Gampsonyx* in the British Museum (July 1958) and in the American Museum of Natural History (October 1958). There can no longer be doubt that in this genus the wing molt always starts with the first (innermost) primary and proceeds to the tenth (outermost) in a quite regular ("descendant") way—the usual order in the Accipitridae. This sequence proves conclusively that *Gampsonyx* does not belong to the Falconidae. Its nearest relatives are obviously *Elanus, Elanoides* and other genera of the "kite" assemblage, as had been accepted by all authors previous to Peters (1931).

I had already reached this conclusion, when my attention was drawn by Dr.

Maria Koepke to a paper dealing with the same question: Ruben Plótnik, "Afinidad entre los géneros *Elanus* and *Gampsonyx*" (Revista de Investigaciones Agricolas, **10,** no. 3, pp. 313–315, Buenos Aires, 1956). After comparing various morphological characters, chiefly the bill, nostrils, and scutellation of tarsus and toes, this author concluded the correct place of *Gampsonyx* was not among the falcons, but near *Elanus*. This view had also been taken by Friedmann (U. S. Natl. Mus. Bull., **50,** pt. 11: 68, 1950). We are thus in complete agreement, though approaching the subject from different sides.—VESTA STRESEMANN, *Wandalenalle 38, Berlin-Charlottenburg, Germany.*

Reverse Mounting in Red-bellied Woodpeckers.—A report on pair formation of Red-bellied Woodpeckers (*Centurus carolinus*) (Kilham, Auk, **75:** 318–329, 1958) discussed reverse mounting observed in this species. In June 1958 I observed the female of a nesting pair of Red-bellied Woodpeckers mount the male on four occasions. The first three incidents occurred during the incubation of the eggs, the fourth after the young had hatched. A second successful brood was brought off the nest in September by this pair, the male of which was marked by a large head scar. Starlings harassed the pair at the nest hole all through the summer, but the male parent brought young of both broods to my feeders.

Each incident of reverse mounting followed the return of the male to the nest area after an absence of from thirty to sixty minutes. The male shared, almost equally during the day, the incubation duties, although he was apparently much more restless than the female during these attentive periods. The male usually returned to a stub at the top of the broken decaying tree and called "churrr", at which the female would come out of the nest hole and inch up the tree stump to join him. The return of the female to the nest was never accompanied by any kind of greeting ceremony. The female usually flew right to the nest hole and waited by it for the male to emerge. Only after the young had hatched did the male fly directly to the nest hole, bringing food.

The first incident of reverse mounting was followed immediately by a brief attempt at coition, after which the female flew away. The other three incidents in which the female "covered" the male appeared to have no sexual significance, but gave the impression that they were an expression of "affection," or perhaps a greeting by the female on her mate's return to relieve her at the nest. Rather than inviting coition, reverse mounting might, on some occasions, be a gesture playing a part in keeping active the family tie.—DORIS C. HAUSER, *309 Sylvan Road, Fayetteville, N. C.*

Black-backed Three-toed Woodpecker in central Pennsylvania.—An adult male Black-backed Three-toed Woodpecker, *Picoïdes arcticus*, was collected December 2, 1958 in Centre County, about 22 miles north of University Park, Pennsylvania, and now is study skin MW1249 in the ornithology collection of The Pennsylvania State University. This specimen was discovered by and secured through Mr. Henry A. Fraser, Mr. Carl Holt and Mr. Russell Fisher of Bellefonte, Pa. Dr. Earl L. Poole of the Reading Public Museum has called to my attention that while this species has been seen before in Pennsylvania, 1928 and 1956 (Cassinia, **42:** 22–23, 1957) and 1957 (Redstart, **24:** 82, 1957), this seems to be the first one collected.—MERRILL WOOD, *The Pennsylvania State University, University Park, Pa.*

Leaf Pulling by the Purple Martin.—The use of green leaves in the nest compartments during the incubation and nestling periods is an interesting habit of the Purple Martin (*Progne subis*), which has been observed repeatedly at the writer's colony located at Manorville, Long Island, New York. Since it has not been seen elsewhere in the area nor found mentioned in the literature, a description seems warranted.

The martin house involved was erected in the spring of 1953 and attracted a number of immature birds, which failed to breed. In 1954 as many as eleven birds were present but only one pair actually nested. The use of green leaves was first noted on June 20 when one of two birds which alighted together in the top of a large Swamp Maple broke off a piece of leaf and carried it into the nest.

In subsequent years the colony increased to eight or nine pairs and the leaf pulling habit became a regular occurrence. A favorite perch of the martins was an old pear tree about fifty feet from their house. Several top branches were dead and the rest were rather sparsely covered with small leaves about one inch long. This tree became the primary source of leaf supply and by mid-summer, the upper branches seemed shredded by a horde of caterpillars. The martins, in spite of vigorous tugging, were seldom able to remove a complete leaf but usually succeeded in obtaining the major part while the tattered remainder was left. It is estimated that several hundred leaves were removed from this tree alone each season. In addition, pieces of leaf were sometimes plucked from other trees in the area. These included Elm, Black Cherry, Scarlet Oak and Swamp Maple. The tough leaves of the oak gave the birds much trouble, for they frequently failed to remove even a small piece after great effort.

Leaf pulling was observed as early in the year as June 5, 1955 about the time egg laying began and as late as August 3, 1958, the day before the last brood left the nest. It seemed to be more frequent after the hatching of the young and was participated in by both sexes. Several times birds were seen removing dried leaves from the nest compartments, and by the end of the nesting season the ground below the house was littered with discarded leaves. It is not known if all were deliberately removed or if some were displaced accidentally as the adults left the nests.

The use of green leaves in the nests of several species of hawks, particularly the Broad-winged Hawk (*Buteo platypterus*), is well known. Their use by this species seems to be analogous.—GILBERT S. RAYNOR, *Manorville, Long Island, New York.*

Sprague's Pipit and Smith's Longspur in Ohio.—On November 15, 1958, the writer collected a Sprague's Pipit (*Anthus spragueii*) at Oxford Airport in west-central Oxford Township, Butler County, Ohio. The airport is approximately 25 miles north-northwest of Cincinnati, Ohio, and 1.5 miles east of the Indiana-Ohio state line. The mean elevation of the airport is 1,038 feet, while the average altitude in southwestern Ohio is about 675 feet. The area includes some 300 acres of which approximately one-third is leased and farmed in various crops, while the other two-thirds is maintained as airport. In the center of this acreage there is a narrow, slightly depressed strip which is permanently swampy except where drained on the airport proper. The grass on the airfield is maintained at a length of 4 inches. The pipit, an adult female, was found in a sparse area where the grass was dead or burned out. This is the first Ohio specimen of the

Sprague's Pipit. The Fifth Edition of the A.O.U. Check-list (1957) defines the United States winter range of this bird as ". . . from southern Arizona, Texas, southern Louisiana, and northwestern Mississippi. . . . Casual in Michigan, South Carolina, Georgia, and Florida." On November 27, 1958, three more Sprague's Pipits were heard and seen at the same place by G. Ronald Austing, Emerson Kemsies, Worth S. Randle, Richard E. Watkins, Paul W. Woodward, and Jean M. Wright. One of these was trapped and banded by this group. The trapped bird and the collected individual were found in similar vegetative situations.

Also present on November 15, 1958, was a flock of thirteen Smith's Longspurs (*Calcarius pictus*). Two (sex undeterminable) were collected by the writer and constitute the first fall records of the species in Ohio. The A.O.U. Check-list reports this species as occurring "casually to . . . eastern Ohio." It has been a regular migrant at the Oxford Airport every spring since 1949 (Kemsies and Austing, Wilson Bull., **62**: 37, 1950), but previous observation had revealed no fall records.

The three specimens have been placed in the University of Cincinnati Collection, where identification was confirmed by Emerson Kemsies, Curator of Ornithology.—JAY M. SHEPPARD, *51 Sherry Road, Wyoming, Ohio.*

Occurrence of Pink Coloration in Adult Female Purple Finches.—During the past five years I have been operating a small banding station with "pull traps" on my lawn baited with mixed seed. I have become particularly interested in the Purple Finch (*Carpodacus purpureus*) and the difficulty in sexing these birds *in vivo*. Purple Finches can be easily divided into three groups, according to coloration: 1) Adult males, showing the deep wine red typical of this species; 2) Brown birds, representing females and immature males; 3) Birds predominantly brown, but showing definite pink, of varying extent and intensity, over head, neck, rump, and sometimes out over the breast. It was this third group that was to me particularly interesting.

During the five year period I have banded 352 birds, of which 43 have returned to my station for two or more years. Of these 43, 25 were unquestionable males. Of these 25, 18 were a deep wine red on first banding, and 7 were brown. Of these 7, trapped as brown birds between April and July of one year, all returned the following year in April or May with the typical deep wine red of adult males. None showed any plumage intermediate between the brown and the deep red coloration of the succeeding spring. One of these males, banded as brown on May 1, 1957, returned the autumn of same year, September 21, 1957, fully red, and again on May 7, 1958, without having had any partial pink plumage.

The remaining 18 birds I have classified as females. Of these eleven have returned showing the definite pinkish color in question. Four of these have been followed for two years, and none has turned into the deep red color typical of the male.

At the fall 1957 meeting of the North Eastern Bird Banding Association I mentioned my theory about pink coloration in the adult female Purple Finch, and met with considerable difference of opinion. I was unable to find any description in the literature of this coloration in the female. Therefore, in the spring of 1958, I collected two specimens of Purple Finch, which I believed to be female, both showing this pink coloration. They were sent to Mr. James C. Greenway,

Curator of Birds, Harvard University. The histories of these two birds are as follows:

55-03635, banded April 9, 1954, brown. Retrapped May 12, 1955, brown; May 16, 1956, definite but slight pinkish coloration on head, neck and rump; May 10, 1958, no significant change since 1956.

57-33730, banded July 6, 1955, brown. April 16, 1957 rather bright pink on head, and neck, extending out onto breast and also on rump. May 10, 1958 still showing the same pink coloration as in 1957. This bird was sufficiently pink that the color was clearly visible at about 50 feet with the naked eye.

These two birds were examined by Mr. Greenway, who reported as follows:

"Both specimens of *Carpodacus purpureus*, sent by you for examination (F. and W. 55-03635 and 57-33730) are mature females. The ovaries of the latter were seen by both Dr. E. Mayr and myself, the former by me. They were normal and slightly enlarged in both, indicating an approaching breeding season."

I therefore believe that adult female Purple Finches, after several years, may show definite pink coloration; and that birds seen exhibiting this pinkish color may be older females, rather than immature males, as described in the literature.—JOHN H. KENNARD, M.D., *967 Elm Street, Manchester, New Hampshire.*

The First Record of Harris' Sparrow, *Zonotrichia querula* (Nuttall), from Alaska.—On June 25, 1958, a female Harris' Sparrow was collected at Nikilik, a site at the mouth of the west arm of the delta of the Colville River, on the arctic coast of Alaska, at 70° 24′ N., 151° 08′ W. The identification has been confirmed by H. G. Deignan of the U. S. National Museum where the skin has been deposited (No. 469581). Dr. F. C. Lincoln who, with Dr. I. N. Gabrielson, has written a comprehensive book, "The Birds of Alaska" (1959), tells me (*in litt.*, July 14, 1958) that they know of no previous record of *Zonotrichia querula* from Alaska. The Harris' Sparrow has not before been recorded within 400 miles of the Colville River, and indeed is not known to be common for as much as 700 miles in an easterly and southeasterly direction (Preble, North American Fauna No. 27, 1908; Porsild, Canadian Field-Nat., **57**: 19–35, 1943). Thee are no records of the species from the Yukon (Rand, Natl. Mus. Canada Bull., 105, 1946). Snyder (Arctic Birds of Canada, 1957) reports only two records of Harris' Sparrow from the barren grounds of Canada (Eskimo Point and Bathurst Inlet).

I was camped at Nikilik from June 13 to July 5. Two wooden houses, which are occupied, stand at this place and are the only prominent features in the flat tundra landscape. The bird was first seen late in the summer evening of June 19, 1958. It called persistently a thin high-pitched phrase *(wee-weee)* from the roof of one or other of the houses. It was extremely shy and, whenever approached, would fly out low over the tundra, or to another perch. The bird remained at Nikilik for five days, using the houses and other objects as places from which to utter its plaintive call. This was particularly evident during night-time hours. It was not until about 0030 hours on June 25 that my native assistant, Tommy Sovalik, was able to collect the bird. The date of the bird's appearance was rather late, for it arrived at Nikilik at a time when the earliest breeding passerines were already hatching. When shot it weighed 33.5 grams. Its habit of advertising its presence from a song post was such as one expects from male passerines, and I was, therefore, surprised to discover that the bird was a female. It is of significance to record that the prevailing daily wind direction recorded by the U. S. Weather

Bureau at Barter Island, Alaska, from June 1-25, 1958, was always between NE and SE, except on the following days—June 12, W; *June 17 and 18 WNW and W.* The bird was first seen the following day.

The bird was collected during a period of study being financed by the Arctic Institute of North America, in part under contractual arrangements with the Office of Naval Research, United States Navy. I was based at the Arctic Research Laboratory.—M. T. Myres, *Department of Zoology, University of British Columbia, Vancouver 8, B. C., Canada.*

Another Collection from Zacatecas, Mexico.—My fifth trip to the Mexican state of Zacatecas in June and July of 1957 resulted in several additions to the birds recorded from the state and information of general faunal or taxonomic interest. Previous reports from the area are those by Webster and Orr (Condor, **54**: 309–313, 1952, and Condor, **56**: 155–160, 1954) and Webster (Wilson Bull., **70**: 243–256, 1958), and localities mentioned but not described below are described therein. Specimens collected are now in the California Academy of Sciences. I was assisted in the field by Richard B. Parker and Jackson R. Webster.

A newly-built road permitted access to extreme southern Zacatecas, down the valley of the Rio Juchipila (Rio Agua Blanca). Eight miles south of Moyahua and four miles south of the village of Santa Rosa, our "Santa Rosa" camp was in well developed tropical deciduous woodland (composed chiefly of two species of *Bursera*) at an elevation of 5600 ft., well up from the river, but near a small permanent creek. Three miles south of Moyahua our "Canyon" camp was beside the muddy Rio Juchipila at 4300 ft. On the west side of the river, a steep talus slope was wooded with deciduous trees and about 500 feet up gave way to vertical cliffs extending upward another 300 feet. "Moyahua" records are from our camp of 1954, 1955, and 1957, 2½ miles north of Moyahua and near the Rio Juchipila at 4300 ft. The deciduous woodland avifauna typical of middle elevations in Nayarit and western Jalisco penetrates up this valley from the Rio Grande de Santiago, as this list shows. (Dates in the annotated list are for 1957, except as noted otherwise.)

All the following 10 species are new for Zacatecas; none have I seen elsewhere in the state than the lower Juchipila Valley, except for one record of the Rufous-capped Warbler:

Leptotila verreauxi angelica. White-fronted Dove. From two to six were seen each day at Santa Rosa, June 29 to July 1. A female was taken June 29.

Coccyzus americanus americanus. Yellow-billed Cuckoo. The call was heard daily at Santa Rosa, June 30 to July 2, and several were seen. A small adult female (wing 146 mm.) with a shelled egg in her oviduct was taken July 1. I saw one at Moyahua July 4, and Dr. Allan Phillips heard one there September 10, 1955.

Tyrannus crassirostris pompalis. Thick-billed Kingbird. A pair was belligerent about a waterfall near Santa Rosa June 30 and July 1; the male was collected. At Canyon a pair was noisy in the big mesquite trees which shaded our camp, July 1 to 3. In 1955, Phillips and I noted one or two a day, September 10 to 12, at Moyahua.

Myiarchus tyrannulus magister. Brown-crested (Wied's Crested) Flycatcher. An immature was taken from a family group of six, July 3 at Canyon. Also, one or two were seen each day, June 30 and July 1 at Santa Rosa, July 2 at Canyon, and July 4 at Moyahua. In 1954, three were seen at Moyahua July 26, and in 1955, one there September 12.

Myiodynastes luteiventris luteiventris. Sulphur-bellied Flycatcher. An adult male was taken July 1 at Santa Rosa. It is definitely nearer the southern, nominate race in its blackish dorsal color and brighter yellow belly, as is a Nayarit specimen and a series from Vera Cruz and Guerrero. Another individual was seen July 3 at Canyon.

Myiopagis viridicata jaliscensis. Greenish Elaenia. This small flycatcher was common in the brush along the creek, June 29 to July 1 at Santa Rosa. Two males were taken.

Thryothorus sinaloa. Bar-vented Wren. Two or three pairs lived along the creek at Santa Rosa, June 29 to July 1. One was seen at Canyon July 3. A singing male was taken June 29; it matches the gray northern race, *cinereus.* However, this suggests a complete rearrangement of the races, which is impossible with the material available.

Basileuterus rufifrons caudatus. Rufous-capped Warbler. A male in breeding condition was taken July 3, in the brush just below the cliffs at Canyon; three were seen there that day and the day before. On the west slope of Monte Escobedo, at about 8400 ft., a flock of five was seen in a brush patch, September 18, 1955. The specimen matches Sinaloa specimens in its brown, dark back, in contrast to the paler, grayer color of specimens from Nayarit, Guerrero, and Est. de México.

Vireo flavoviridis hypoleucus. Yellow-green Vireo. Several were singing along the creek at Santa Rosa June 30 and July 1, and a male was taken from a flowering magnolia tree. Two were seen July 2 at Canyon, and one July 4 at Moyahua.

Aimophila ruficauda nayaritensis. Rufous-tailed Sparrow. A flock was seen in a weedy field beside the river, downstream from Canyon, July 2 and 3, and two non-breeding adult males (wing 65, 69 mm.; tail 68, 72 mm.) in fresh plumage were collected. Together with a male (wing 68; tail 66) from Cocula, Jalisco (Museum of Vertebrate Zoology, studied through the courtesy of Dr. Alden H. Miller), these birds seem to represent the northwestern race described by Van Rossem (Bull. Brt. Orn. Cl., **58**: 124–138, 1935). They are darker and redder, less gray and pale than any of 26 specimens from Michoacan, Morelos, and Guerrero. The size differences claimed by Van Rossem don't pertain to these Jalisco and Zacatecas birds.

Six other species of more general distribution in Zacatecas were collected in the state for the first time:

Aëronautes saxatalis saxatalis. White-throated Swift. A large flock played around the cliffs at Canyon, July 2 and 3; a male and a female were shot as they flew in toward cracks in the cliff; each had a mouthful of freshly-caught insects when retrieved. On July 17, a group of four was seen at Momax. Previously, I saw two or three each day July 16 to 24, 1950, at Sombrerete; a flock of six at Cerro Gordo September 6, 1955; and several each day at Moyahua, September 9, 10, and 13, 1955.

Amazilia beryllina viola. Berylline Hummingbird. A male was taken July 14, in oak woods in a shaded ravine, 3 miles northwest of Teul de Ortega. Several others were seen there, July 14 to 16. In 1954, I saw one in juniper-pinyon country at Cerro Gordo July 2; in 1955 Phillips saw one in the oaks at the edge of the barranca west of Monte Escobedo, September 17.

Myiarchus tuberculifer querulus. Olivaceous Flycatcher. A female with a well-developed brood patch was collected June 23, 13 miles west of Milpillas, in pine-oak woods at the edge of a barranca. One or two were heard or seen almost every

day in this habitat in western Zacatecas in June and July of 1952, 1954, and 1957. In the fall, we noted one or two a day, September 10 to 13, 1955, at Moyahua.

Camptostoma imberbe. Beardless Flycatcher. I am unable to allocate to subspecies a female taken July 4 at Moyahua. From one to three were seen each day at Rio Florido in June and July, 1952 and 1954; in the Juchipila Valley, from 4 miles north of Jalpa to Moyahua, in September, 1955; and in the Juchipila Valley in June and July, 1957, at Santa Rosa and Moyahua.

Stelgidopteryx ruficollis psammochrous. Rough-winged Swallow. An adult female taken July 12, 9 miles west of Zacatecas City, and an immature male taken July 17 at Momax are slightly darker (blacker) dorsally than comparable specimens of *psammochrous*. This suggests a tendency toward *stuarti*, of the highlands of southern Mexico. I saw the species daily in small numbers along almost every river in western Zacatecas in June and July, 1954 and 1957, and in September, 1955. Pairs entered nesting holes in sandy banks at Rio Florido June 20, 1954, and at Moyahua, July 4, 1957.

Phainopepla nitens. Phainopepla. An adult female was taken, and another seen, July 25 and 26, near the eastern border of Zacatecas, in a desert flat grown to tree yuccas at 6600 ft. on the north slope of the Sierra Rocamonte (Sierra Encarnación of Goldman). In the western part of the state Phainopeplas are uncommon, but individuals were seen in Acacia grassland June 17, 1952, 11 miles northwest of Sombrerete at 7000 ft.; in oaks at 7700 ft. just east of Monte Escobedo, July 22, 1954; and near El Cruz, 10 miles west of Fresnillo, at 7000 ft. in Acacia-cactus scrub, June 26, 1957. Subspecific allocation of the single specimen is impossible.

One common species merits comment:

Pyrocephalus rubineus flammeus. Vermilion Flycatcher. An adult male was taken July 21 at Rio Florido. The color and the large size (wing 86 mm., maximum even for *flammeus*) require that this specimen be assigned to the northern race. I measured 56 other adult males of the larger race, *flammeus*, from Texas, Arizona, California, Baja California, Sonora, and Sinoloa, and several of *mexicanus* from Guerrero and Vera Cruz. The species is ubiquitus in Zacatecas, chiefly along streams from 4000 to 7800 ft., but also far from water in grassland and desert areas. The basis for the extension of the range of *mexicanus* north to Zacatecas by Miller, *et al.* (Pac. Coast Avif., **33**: 69, 1957) should be re-examined.—J. Dan Webster, *Hanover College, Hanover, Indiana and California Academy of Sciences, San Francisco.*

Cowbird Parasitizes Nest Containing Young.—The deposition of eggs by the Brown-headed Cowbird *(Molothrus ater)* in the nest of a host species containing young is evidently a rare occurrence. Friedmann (The Cowbirds. A study in the biology of social parasitism: 186, 1929) says, "Normally, Cowbirds do not lay in nests containing eggs in which incubation is well started, but a Cowbird has been known to lay an egg in a nest of an Indigo Bunting, containing young. This was a very exceptional case and was doubtlessly a last resort in an emergency." Bent (U. S. Natl. Bus. Bull., **211**: 421–450, 1958) mentions no such case.

During the summer of 1957, the nest of a Red-eyed Vireo *(Vireo olivaceus)* produced another instance. The nest was located on the Edwin S. George Reserve, near Pinckney, Livingston County, Michigan. When first discovered, June 11, the nest contained four vireo eggs. The contents were the same June 13, but on June 15 it held only two newly-hatched vireos. Beneath the nest were broken, vireo

eggshells. On June 17 the nest contained one young vireo and one cowbird egg. I was, unfortunately, unable to visit the nest again until June 22, when I found it empty; a broken cowbird egg lay on the ground beneath it.

One interesting point in connection with this nest is the fact that a young vireo had disappeared from it when the cowbird egg was discovered. This causes one to ponder whether the cowbird removed the vireo before laying. Perhaps some future worker will be fortunate enough to observe such behavior.—RUSSELL E. MUMFORD, *Department of Forestry and Conservation, Purdue University, Lafayette, Indiana.*

Living Nematodes Within Hen's Eggs.—Wood and Mizelle (Journ. Parasitology, **41**: 115, 1955) summarized approximately a dozen known occurrences of the nematode *Ascaridia galli* Schrank within eggs of the domestic chicken (*Gallus gallus*). None of the references cited were in the ornithological literature. An additional occurrence is here described, in order to call this phenomenon to the attention of ornithologists who may be unfamiliar with it.

On November 17, 1958, Mrs. E. Ghidoni of Pittsburgh brought to me a nematode which she had found, alive, in the albumen of a hen's egg that morning. She stated that there had been no visible flaw in the shell. The specimen, exactly 100 mm. long, was identified by Mrs. M. B. Chitwood of the U.S.D.A. Agricultural Research Center, Beltsville, Maryland, as a gravid female of *Ascaridia* sp., probably *A. galli*. It is now no. 56190 in the United States Helminthological Collection.

In order to be enclosed within the egg shell, it is obvious that the nematode, normally an intestinal parasite, must have been present within the oviduct at the exact time and place of shell formation. Wood and Mizelle (*op. cit.*) stated, "It is thought that entry into the oviduct was *via* the cloaca, however, the possibility of penetration of the gut and oviduct should not be overlooked."

This phenomenon has apparently not been reported in other species of birds. Collectors who are blowing eggs, particularly of species known to have an abundance of internal parasites, might watch for worms included within the shell. That the chances are slim, indeed, of finding such inclusions is indicated by the small number of reports of *Ascarida*, a common parasite of chickens, within eggs, although the annual consumption of eggs in the United States alone exceeds sixty billion.

I am indebted to Dr. Allen McIntosh for the Wood and Mizelle reference cited above.—KENNETH C. PARKES, *Carnegie Museum, Pittsburgh, Pennsylvania.*

A.O.U. Meeting in Regina—A Reminder

The 1959 A.O.U. meeting will be held at Regina, Saskatchewan, August 25–30. Headquarters: Hotel Saskatchewan. Chairman of the Subcommittee on Accommodations and Transportation: Frank H. Brazier, 2657 Cameron Street, Regina.

REVIEWS

Zoogeography: The Geographical Distribution of Animals.—Philip J. Darlington, Jr. 1957. xi + 675 pp., 80 text figs. John Wiley & Sons, Inc., New York. $15.00.—A zoogeographer must have an unusually broad background: he must know many regions of the world (preferably from having studied them first hand); he must have a specialized knowledge of the systematics and distribution of one group of animals and a broad knowledge of both plants and animals; he must have an historical viewpoint, not only with respect to animal distribution but also with respect to geography, climate, and evolution; and he should be in a position to broaden his background through close contact with specialists in other groups of organisms than his own. On these bases, the author of the present text is admirably qualified, and it is gratifying to find that he has produced a book in which a tremendous quantity of useful information is collated.

Following the introduction, are chapters on the distribution of the fresh-water fishes, amphibians, reptiles, birds, and mammals. The second half of the book contains discussions of continental patterns and faunal regions, island patterns, evolution of the geographical patterns, the past in the light of zoogeography, the principles of zoogeography, and the geographical history of man. The writing is straightforward, if at times somewhat ponderous, and the reader is frequently referred to other parts of the book for information bearing on the matter being discussed. It is a book to be studied rather than read for pleasure or casual information.

This, I think, is an appropriate place to protest the repeated statements to the effect that fossil birds can tell us little about either the phylogeny or past distribution of the group. Such statements by influential biologists are often based on lack of knowledge or interest in the field and have been responsible for delaying important and much needed work in paleornithology. While fossils of birds are far fewer and often less complete than those of mammals, there are now in museums thousands of unstudied bird fossils. Nor are these by any means all from Pliocene or Pleistocene deposits; there are, for instance, many hundreds of beautifully preserved bird bones from late Oligocene or early Miocene deposits in Europe, the study of which will undoubtedly add valuable information on the phylogeny of several groups.

Darlington's mistaken attitude toward paleornithology has resulted in the most serious errors and omissions in the chapter on birds. Gregory's important study (Condor, **54**: 73–88, 1952) showing that the jaws attributed to *Ichthyornis* were in reality those of a mosasaur was evidently overlooked, for the Ichthyornithes are listed as toothed birds. Another omission was Miller's study of the Miocene hoatzin (*Hoazinoides*) suggesting relationships of that group to the cracids (Auk, **70**: 484–489, 1953). *Mancalla*, which was approximately the size of a murre, is said to have been "comparable to the Great Auk in large size and in reduction of wings." Actually, *Mancalla* had gone considerably beyond the Great Auk in the approach to a penguin-like flipper. (And it should be added that those who have carefully studied this fossil agree that it is distinct enough, not only in the structure of the wing but also in the leg and other structures, to merit family rank.) Another family not recognized is that of the straight-billed relatives of the flamingos, the Paloelodidae. This is one of the best-known fossil groups (four Oligocene or Miocene species alone are represented by hundreds of well-preserved bones) and is universally recognized by students of fossil birds. Including it in the Phoenicopteridae and omitting the Telmabatidae altogether will be responsible for any failure

to give the student an understanding of the widespread radiation of the flamingo-like birds in the early Tertiary.

Considering the extent to which a zoogeographer must rely on others for collecting and evaluating his factual material, Darlington's book is well prepared and contains fewer errors than the first editions of most texts. Tighter organization of the material would have made specific information easier to locate and, by reducing the number of pages, would have made the book less expensive.—ROBERT W. STORER.

Wild Paradise. The Story of the Coto Doñana Expeditions.—Guy Mountfort. 1958. 240 pp., 130 photos. chiefly by Eric Hosking; text figs. Houghton Mifflin Co., Boston, Mass. $7.00. Originally published in England as "Portrait of a Wilderness", this is an enjoyable report of three trips by an international group of distinguished bird students to an area on the southwest coast of Spain, between the vast *marismas* (salt marshes) at the mouth of the Guadalquivir and the Atlantic. The Coto Doñana, a private estate of some 67,000 acres, is one of the last comparatively unspoiled lowland districts remaining in western Europe. It is sandy country, with heaths, pinewoods, cork-oak savannah and marshland, remarkably rich in birds. About half the birds known from Europe have been observed in this region. Ecologically it is much like the well-known Camargue of the Rhone Delta, but the scantiness of the human population, the protection afforded by its aristocratic owners, and the proximity to Africa have preserved in the Coto Doñana a greater variety of breeding species, especially herons, ducks, and birds of prey. Raptors of 11 species are reported to breed regularly and 27 have been observed. Among the many splendid photographs, those of several species of rare birds of prey are notably fine. Though designed as a popular, informal account, the book contains much significant information on behavior, ecology and identification aids, as well as lists of all tetrapod animals noted. An ecological chapter by E. M. Nicholson is very good.

The future of the *marismas*, with their great water-bird colonies, is far from secure. Unless large areas are soon set aside as permanent sanctuaries before the pressures for modernization become insuperable, Europe and the world—not merely Spain—will lose a precious and irreplaceable natural resource. In these times of rapid change, the enlightened conservation interest of the present Coto Doñana owners gives no assurance of permanent protection for even that area.—E. EISENMANN.

Bird Hybrids. A Check-List with Bibliography.—Annie P. Gray. 1958. x + 390 pp. Commonwealth Agricultural Bureaux, Farnham Royal, Bucks, England. Price 50 s. This book is a very useful compilation of recorded avian hybrids. The overall organization of the book is good. Hybrids are listed under the name of each parental form, generally following the Wetmore classification as to order and family, but with the genera and species listed alphabetically under each family. For each reported cross the author gives the sex of each parent (when known), information on the fertility or sterility of the F_1's, backcrosses (if any), and literature references (with indication of whether the hybrid is pictured). Lack of success in attempts to obtain hybrids is also reported in many cases. The author shows extreme care in dealing with the reliability of the reported hybrids, the text being replete with such phrases as "presumed hybrid," "alleged hybrid," "reported hybrid," "reputed hybrid," etc.

The greatest number of hybrids are reported for the Anatidae (covering 69

pages), the Galliformes (42 pages, many inter-family crosses), and the Psittacidae, Ploceidae and Fringillidae (35 pages each). To some extent this reflects the fact that these are the groups most frequently bred in captivity. However, natural hybrids between distinct species of ducks and game birds seem to be more frequent than among many other groups (see Sibley. 1957. Condor, **59**, 166–191, for a discussion of hybridization in such groups as the Anatidae and the Galliformes).

The book seems strongest in the compilation of data from avicultural journals. Unfortunately, numerous references to wild hybrids have been overlooked. Some of these references are not easy to find, for they may not be indexed under "hybrid." Yet most taxonomic works of broad geographic scope discussing speciation or subspeciation of many species mention additional interspecific hybrid specimens. For example, many are mentioned in the footnotes of Hellmayr's "Catalogue of Birds of the Americas," in Chapin's "Birds of the Belgian Congo," and in Vaurie's series of papers "Systematic Notes on Palearctic Birds" (Amer. Mus. Novit.). Some of the putative hybrid situations overlooked, discussed lately in leading journals, involve species of the genera *Alauda, Ceyx, Chalcomitra, Contopus, Gymnorhina, Jacana, Neositta, Myzomela, Mimus, Pachycephala, Pardalotus, Petroica, Remiz, Sphyrapicus,* and *Tricholaema*. One strange oversight is that of the hybrid *Dendrocopos scalaris* x *D. villosus* reported by Miller (1955. Evolution), even though that paper is cited for another hybrid mentioned. Some major recent papers dealing specifically with hybridization were also overlooked, as for example, Sutton (1938. Auk) on *Icterus galbula* x *I. bullockii,* Huntington (1952. Systematic Zoology) on *Quiscalus,* and Williamson (1955. British Birds), Mayr (1956. British Birds), and Sammalisto (1956. Ornis Fennica) on the *Motacilla flava* complex. A surprising error is the listing of a parulid hybrid of the genus *Wilsonia* under Turdidae. The supposed hummingbird hybrid between *Melanotrochilus* and *Thalurania,* included on the authority of Ruschi, was later reported by the same author to be an artifact (Bol. Mus. Biol. Prof. Mello-Leitão, no. 10: 86, 1951).

Despite the incomplete coverage of the literature, the book is an important reference work for the aviculturist and the general ornithologist, as well as for the systematist.—Lester L. Short, Jr.

The Birds of Alberta.—W. Ray Salt and A. L. Wilk. 1958. 511 pp., 313 ills., many in color. The Queen's Printer, Edmonton, Alberta. Price, $5. This book is "intended to be an aid primarily to those who are not too well acquainted with the birds of Alberta," to assist in identification, and to help the observer find the birds. Every species is illustrated, usually in color. The color drawings (most of which have appeared in other Canadian works) vary greatly in quality; some of the new ones seem definitely amateurish. Certain of the color photographs are interesting. To the ornithologist the book is chiefly valuable for the maps showing the distribution and status in Alberta of each species. The main text does not treat subspecies, but these are listed in a check-list at the end. Alberta residents and visitors will find this a useful compendium.—E. Eisenmann.

Birds of Cyprus.—David A. Bannerman and W. Mary Bannerman. 1958. lxix + 389 pp., map, many line drawings, 30 pls. (16 in color). Price 63 s. Oliver & Boyd, Tweeddale Court, Edinburgh, Scotland. Glancing through this handsome book, one can hardly avoid a nostalgic regret at the passing of the British Empire. Let the British control an area and ornithology is almost always enriched by a useful, and often sumptuous, work facilitating the identification of the avifauna.

(The Western Hemisphere colonies have been somewhat neglected—perhaps a by-product of the Monroe Doctrine!) Americans have not done nearly so much for students of neotropical birds; fewer of our officials have been bird-watchers.

The chief ornithological interest of this Mediterranean island is as a migration way-station. Of the 333 species treated, only 71 are said to breed. The listed endemic forms include one species (possibly only a strong subspecies) and 13 subspecies (some doubtfully distinguishable from mainland populations). The systematic treatment is not the most modern. For each species there is a description, usually an illustration, data on habitat, nesting status, and migration. The low price of such a beautifully printed book was made possible by the support of the Cyprus government and the gift of the color plates by a number of private persons. The expense of producing each color plate (including the artist's fee) is stated to have been £50. These plates, mostly by D. Reid-Henry, have been reproduced with such superb clarity that they should make Americans blush at the sloppy jobs that we tolerate, at enormously higher costs, from our engravers and printers.—E. Eisenmann.

Mexican Bird Songs.—Recorded by L. Irby Davis. 1958. 33-1/3 RPM. 12-inch vinylite record. Laboratory of Ornithology, Cornell Univ. Cornell University Records, 124 Roberts Place, Ithaca, N. Y. Price, $7.75. We have here good recordings of 74 Mexican species. The growing number of persons interested in neotropical birds will find this a useful and evocative contribution. Its scientific value would have been enhanced had we been told, at least on the jacket, the locality and date of each recording. (The jacket only gives the technical species name and an English name—not always that of current check-lists and books; *e.g.*, "Gray" Robin for the brown bird today generally designated Clay-colored Robin.) Almost all the species have a broad neotropical range outside of Mexico. This, of course, adds greatly to the appeal of the record, but considering the likelihood of individual, seasonal, and geographical variation in voice, information on locality and date are needed that comparisons may be made, not only between different subspecies, but between different populations. This comment is not made in derogation of Mr. Davis' valuable work (for it may be assumed that he provided such data with his tapes); it is a suggestion to publishers who wish to give maximum ornithological significance to their recordings.

With the increasing use of voice as a taxonomic aid, one other suggestion may be in order. The vocalizations here generally captioned "songs" are surely in some cases merely flocking calls, or the like. Admittedly, there is uncertainty as to the function of particular bird notes, but to facilitate comparisons distinction can usually be made between the more elaborately patterned vocalizations called "songs" and those broadly designated "calls." With many neotropical birds, we may not yet know enough to be able to make even this inadequate classification. The recorder of bird voices could help other students were he to indicate (so far as he can), and forward to the laboratory where his tapes are preserved, the circumstances surrounding each vocalization recorded, the bird's behavior at the time, and whether the same individual was heard to utter other notes that were not recorded. It would not be feasible to print all this on a record jacket, but a brief descriptive leaflet could be included with the more scientific records, or at least mention could be made that such data are available to students by inquiry at the recording laboratory.—E. Eisenmann.

RECENT LITERATURE

EDITED BY FRANK McKINNEY

Anatomy and Embryology

Bährmann, U. 1959. Zur Mauser einiger Rabenvögel. Vogelwelt, **79** (5): 129–135. The molt of *Corvus cornix*, *Coloeus monedula*, *Pica pica* and *Garrulus glandarius*.

Behavior

Bergman, G. 1958. Auslösung von Übersprungseinschlafen sowie Ermüdung der akustisch ausgelösten Revierverteidigung durch Magnetophonwiedergabe der Aggressionlaute beim Steinwälzer (*Arenaria interpres*). Ornis Fennica, **35**: 151–154. The release of displacement activity and the exhaustion of territorial defense released by recorded reproduction of the aggression call of the Turnstone. (In German; Finnish summary.)

Hall, K. R. 1958. Observations on the nesting sites and nesting behaviour of Kittlitz's Sandplover *Charadrius pecuarius*. Ostrich, **29**: 113–125.—The data on distraction display is of general interest.—E. E.

Hanes, J. W., Jr. 1958. Some notes on a Bachman's Warbler and his song. Atl. Nat., **13**: 233–235.

Hartshorne, C. 1958. The relation of bird song to music. Ibis, **100**: 421–445. —The author, involved in studies of "singing" of birds for some years, continues his intricately reasoned and intriguing, if for the most part "unprovable," speculation here. Bird song is considered as primitive music and "as an evolutionary anticipation of human music." Evidences given to support this theory are seen in the use by birds of elementary musical devices, avoidance of mechanical regularity, learning of songs and tunes, partial non-utilitarian nature and playful cultivation of sound production, association of quality of singing with quantity of singing.—J. W. H.

Hess, E. H. 1958. "Imprinting" in animals. Scientific American, **198**: 81–90.—Laboratory studies of imprinting using mallard ducklings and a mechanical model of a male mallard indicated that there is a critical age for imprinting which reaches a peak when the ducklings are 16 hours old. It was found that the distance traveled by ducklings during the imprinting period was positively correlated with the degree of imprinting attained. The time that elapsed during the imprinting period had little effect on the degree of imprinting.—J. C. H.

Højgaard, M. 1958. Observations and experiments conducted on a tame Blue Tit (*Parus caeruleus* L.). Dansk Orn. Foren. Tidsskr., **52**: 12–40.—A male Blue Tit reared for about a year from a fledgling showed no fear of predators, even when other birds reacted strongly. Unfamiliar objects of contrasting colors did arouse fear. Calls normal to wild Blue Tits were uttered, but not the song. Experiments showed ability to learn quickly to discriminate between form and even number. During the winter, and increasingly in the spring, the bird attempted to copulate on the hands of persons.—E. E.

Humphrey, P. S. 1958. Diving of a captive Common Eider. Condor, **60**: 408–410.

Kareila, R. 1958. Observations of birds breeding in the mountains Urtasvaarri, with special reference to the behaviour of the Snow Bunting (*Plectrophenax nivalis*). Ornis Fennica, **35** (4): 140–150. (In Finnish; English summary.)

Kilham, L. 1958. Territorial behavior of wintering Red-headed Woodpeckers.

Wilson Bull., 70: 347–358.—Twelve *Melanerpes erythrocephalus* wintered in a four acre woods containing many acorns. Each woodpecker protected a territory, containing a roost hole and acorns that it had stored, from birds of the same and other species.—J. T. T.

KLOPFER, P. H. 1958. Influence of social interactions on learning rates in birds. Science, 128: 903.—Greenfinches (*Chloris chloris*) learned avoidance responses in feeding more efficiently when feeding alone than when a member of a pair. —J. C. H.

LANYON, W. E. 1958. The motivation of sun-bathing in birds. Wilson Bull., 70: 280.—Evidence is presented indicating that warmth may stimulate the sun-bathing behavior.—J. T. T.

LANYON, W. E., AND W. R. FISH. 1958. Geographical variation in the vocalizations of the Western Meadowlark. Condor, 60: 339–341.

LEBRET, T. 1958. The "jump-flight" of the Mallard, *Anas platyrhynchos* L., the Teal, *Anas crecca* L. and the Shoveler, *Spatula clypeata* L. Ardea, 46: 68–72.—The jump-flight display of these three species is described and discussed with emphasis on its seasonal distribution, significance, and analogous behaviors in other species.—W. C. D.

LEBRET, T. 1958. Inciting ("hetzen") by flying ducks. Ardea, 46: 73–75.—This behavior is discussed for the Mallard and other dabbling ducks.—W. C. D.

LEBRET, T. 1958. Baltsbewegingen van het Nonnetje, *Mergus albellus* L. Ardea, 46: 75–79.—Social display movements of the Smew are described. Comparable movements of other ducks are mentioned.—W. C. D.

LÖHRL, H. 1958. Das Verhalten des Kleibers (*Sitta europaea caesia* Wolf). Zeitschrift für Tierpsychologie, 15: 191–252.—This five-year study of the European Nuthatch has resulted in a very valuable and scholarly presentation of the behavior of this species throughout its entire life cycle. Feeding behavior, territoriality, nesting, sexual behavior, agonistic behavior, development of behavior in the young, etc. are all treated thoroughly. (English summary.)—W. C. D.

LOVELL, H. B. 1958. Baiting of fish by a Green Heron. Wilson Bull., 70: 280–281.—A *Butorides virescens* was observed repeatedly placing pieces of bread in the water and catching fish that were attracted by the bread.—J. T. T.

MEYERRIECKS, A. J. 1958. The amateur and the study of bird behavior. Bull. Mass. Aud. Soc., 42: 127–133.—Useful hints on the methods and value of bird behavior studies; with bibliography.—E. E.

MILLER, R. C. 1958. Morning and evening song of robins in different latitudes. Condor, 60: 105–107.—Data are presented to show that morning song begins and ends progressively earlier with increase in latitude and that duration of morning song increases with latitude. Evening song tends to terminate earlier at higher latitudes.—D. W. J.

NOLAN, V., JR. 1958. Singing by female Indigo Bunting (*Passerina cyanea*) and Rufous-sided Towhee (*Pipilo erythrophthalmus*). Wilson Bull., 70: 287–288.

OEHME, H. 1958. Die "Landung" der Vögel. Beitr. z. Vogelkunde, 6 (4): 251–261.—Landing methods of birds, with diagrams and photos.

PETZOLD, H-G. 1958. Einige Bilder und Gedanken zum Thema "Kronismus beim Weissstorch." Beitr. z. Vogelkunde, 6 (4): 261–265. Photographs and discussion of the killing by the White Stork of its own young.

SCHMIDT, G. 1959. Zum Sozialverhalten von Tauchenten (*Aythya*) bei Eisgang. Ornith. Mitteil., 11: 58.—In February when the bays began to freeze at Kiel,

Germany, the Tufted Ducks and Greater Scaup followed each other in single file through the open passages in the ice, thus tending to keep them open.

Diseases and Parasites

Ezzat, M. A. and G. Tadros. 1958. Contribution to the Helminth fauna of Belgian Congo birds. Ann. Mus. Roy. Congo Belge Tervuren, Sci. Zool., 69: 1–81.

Gutiérrez, R. O. 1956. El ganso común *Coscoroba coscoroba* (Molina, 1782) huésped de *Dicheilonema rhea* (Owen, 1843). Holmbergia, 5 (12–13): 227–232. Coscoroba Goose host of a nematode parasite hitherto known only from the Rhea, *Rhea americana*.—E. E.

Distribution and Annotated Lists

Gilliard, E. T. 1959. Notes on some birds of northern Venezuela. Amer. Mus. Novit., 1927: 33 pp.—Brief notes on 104 species seen between April 17 and May 2, 1955. Of particular interest are observations on breeding behavior, including descriptions of nests of 19 species A counterbalanced, suspended nest of *Phaethornis augusti* is figured. There is evidence that *Stelgidopteryx ruficollis* appropriates nest burrows dug by *Galbula ruficauda*. Eggs of *Molothrus bonariensis* were found in nests of *Turdus leucomelas* and *Tachyphonus rufus*. In cooperation with E. Eisenmann, further progress is made in the standardization of English vernacular names for Neotropical birds.—K. C. P.

Hayward, C. L. 1958. Additional notes on the Purple Martin in Utah. Condor, 60: 406.

Holgersen, H. 1958. Sjeldne gjester i den Norske fuglefauna. Stavanger Mus. Årbok 1957, 103–111. (In Norwegian).—Lists the following of interest from North America: *Botaurus lentiginosus, Erolia melanotos, Erolia alpina arctica,* and *Oenanthe oenanthe leucorrhoa.*

Hooker, T. 1958. Birds seen on the eastern Canary Island of Fuerteventura. Ibis, 100: 446–449.

Howell, T. R. 1958. Cape May Warbler in Nicaragua. Condor, 60: 142.

Hüe, F., and R. D. Etchécopar. 1958. Un mois de recherches ornithologiques aux îles Canaries. La Terre et la Vie, 105 (3): 186–219.—The present status of birds in the Canaries, and their distribution.—E. E.

Johnson, N. K. 1958. Notes on the Red Crossbill in Nevada. Condor, 60: 136–138.

Kessel, B., and T. J. Cade. 1958. Birds of the Colville River, Northern Alaska. Biol. Pap. Univ. Alaska, No. 2: 1–83. Price, $1.—This list of the species recorded from a major sector of Arctic Alaska, gives data on local distribution, abundance, habitat, breeding, migration and behavior. There are useful tables of the avian habitats, indicating whether used for nesting, courtship, foraging, resting or escaping. The 90 breeding species of the Arctic slope of Alaska are tabulated as to their preferences for the coastal, foothill, or alpine zones of the area. Exceptionally interesting for an annotated list are some of the behavioral items included; *e.g.*, the breeding association of Canada Geese with Rough-legged Hawks, Gyrfalcons and Peregrine Falcons, the latter two being intolerant of each other.—E. E.

Kenyon, K. W., and D. W. Rice. 1958. Birds of Kure Atoll, Hawaii. Condor, 60: 188–190.—An annotated list of sixteen species is presented, and estimated populations of 13 resident sea birds are given. Red-tailed Tropic-birds and Laysan Albatrosses were the most abundant forms.—D. W. J.

LIVERSIDGE, R. 1958. A species new to South Africa *Xema sabini* (Sabine). Bull. Brit. Orn. Club, **78**: 149–150.—A Sabine's Gull taken off Slang Bay, Cape Province, Feb. 26, 1958, the first for the Indian Ocean.—E. E.

LIVERSIDGE, R., G. F. BROEKHUYSEN, AND A. R. THESEN. 1958. The birds of Langebaan Lagoon. Ostrich, **29**: 95–106.—A tidal lagoon on the Atlantic coast of South Africa is particularly rich in migrant waders. Many Palearctic waders remain during the months when the species are breeding in the north.—E. E.

MARCHANT, S. 1958. The birds of the Santa Elena Peninsula, S. W. Ecuador. Ibis, **100**: 349–387.—A systematic account is given of the birds of this most arid part of southwestern Ecuador, based on 420 specimens collected between 1954 and 1957. Status of species, elements of the fauna, seasonal movements, effects of environmental conditions and man-made alterations, and matters of taxonomy are discussed.—J. W. H.

MOLTONI, E. 1958. La Rondine di mare maggiore—*Hydroprogne caspia* (Pallas)—in Italia. Riv. Ital. Orn., **28**: 218–223.—A review of Italian specimens of the Caspian Tern.—E. E.

MOREAU, R. E. 1958. Notes on Musophagidae. Ibis, **100**: 620–621.—The author gives information, provided by correspondents, that supplements his recent long papers on the Musophagidae (Ibis, 1958. **100**: 67–112, 238–270). The new information extends ranges and habitats of certain species, and corrects minor errors of omission and transposition in the longer papers.—J. W. H.

MYRES, M. T. 1958. The European Starling in British Columbia: 1947–1957. Occ. Pap. Brit. Colum. Prov. Mus., no. **11**: 1–60.—Reached British Columbia 55 years after its introduction on the Atlantic coast in New York; now a common and widespread breeder.—E. E.

OLROGG, C. C. 1958. Notas ornitológicas sobre la colección del Instituto Miguel Lillo, Tucumán. III. Acta Zool. Lilloana, **15**: 5–18.—Distributional and taxonomic notes on Argentine birds in the collection of the Instituto Miguel Lillo, Tucumán, Argentina. Described as new: *Larus belcheri atlanticus, Scapaneus leucopogon major*. Examination of the type indicates that *Asthenes pyrrholeuca leptasthenuroides* (Lillo) has priority over *A. p. affinis* (Berlepsch). Supposed records of *Atticora c. cyanoleuca* from northwestern Argentina are questioned; all examples seen from Tucumán, Salta and Jujuy belong to *patagonica*. (In Spanish; English summary.)—E. E.

OLROGG, C. C. 1958. Observaciones sobre la avifauna antarctica y de alta mar desde el Rio de la Plata hasta los 60° de latitud sur. Acta Zool. Lilloana, **15**: 19–33. Results of a voyage to the South Orkneys, the South Shetlands, and Antarctic areas. (In Spanish; short English summary.)—E. E.

ORLANDO, C. 1958. Cattura di un Albatro urlatore (*Diomedea exulans exulans*, Linnaeus) in Sicilia. Riv. Ital. Orn., **28**: 101–113.—Full account of capture of a live male immature Wandering Albatross near Palermo, Sicily on Oct. 4, 1957, with photographs. Weight in flesh, 6.8 kgms.—E. E.

RAUSCH, R. 1958. The occurrence and distribution of birds on Middleton Island, Alaska. Condor, **60**: 227–242.—This is another significant annotated list coupled with a rather detailed study of ecologic formations. Emphasis is given to these formations (six of them), and the breeding birds of each formation are given with certain annotations. Finally, twenty-five transient species are listed.—D. W. J.

Ecology and Population

Bookhout, T. A. 1958. The availability of plant seeds to bobwhite quail in southern Illinois. Ecol., **39**: 671–681.—Little correlation was found between available plant seeds and frequencies and volumes of seeds taken.—S. C. K.

Curio, E. 1958. Geburtsortstreue und Lebenswartung junger Trauerschnapper (*Muscicapa h. hypoleuca* Pallas) Vogelwelt, **79** (5): 135–148. A careful study of birthplace fidelity and life expectancy in young Pied Flycatchers of the Berlin area.

Fallet, M. 1958. Der Jahresrhythmus eines grossstädtischen Bestandes des Haussperlings (*Passer domesticus*). Schriften Naturw. Ver. Schleswig-Holstein, **29**: 39–46. The annual population rhythm of the House Sparrow at Kiel, Germany. In December the population was 15,000; by the start of the next breeding season only 10,000. In late summer the population had increased by at least 11,250 more, yet brood dispersal, etc. reduced the total to about 17,000 in autumn.—E.E.

MacArthur, R. H.—1958. Population ecology of some warblers of northeastern coniferous forests. Ecol., **39**: 599–619.—Detailed analysis of niche requirements of Myrtle, Black-throated Green, Blackburnian, Cape May, and Bay-breasted Warblers.—S. C. K.

Morris, R. F., W. F. Cheshire, C. A. Miller, and D. G. Mott. 1958. The numerical response of avian and mammalian predators during a gradation of the spruce budworm. Ecol., **39**: 487–494.—During a spruce budworm outbreak in New Brunswick, Bay-breasted, Blackburnian, and Tennessee Warblers increased in numbers and Magnolia, Myrtle, and Black-throated Green Warblers decreased. Rodents and insectivores varied mostly independently. Mammal and avian predators had little control value on the outbreak.—S. C. K.

Mossman, A. S. 1958. Selective predation of Glaucous-winged Gulls upon adult red salmon Ecol., **39**: 482–486.—Gulls kill proportionately more female than male salmon.—S. C. K.

Preston, F. W. 1958. Analysis of the Audubon Christmas counts in terms of the lognormal curve. Ecol., **39**: 620–624.—Christmas bird counts approximate a log-normal curve except for an excessive number of species represented by one or two individuals and an underestimation of the numbers of very common species.—S. C. K.

Sharp, W. M. 1958. Microclimatic influences created by ground nesting birds. Ecol., **39**: 757.—Body heat of incubating birds stimulates increased growth of surrounding grasses and forbs. "Preening" the grass blades induces them to form an arch over the nest.—S. C. K.

Evolution and Genetics

Bock, W. J. and W. DeW. Miller. 1959. The scansorial foot of the woodpeckers, with comments on the evolution of perching and climbing feet in birds. Amer. Mus. Novit., **1931**: 45 pp.—An important paper, actually written by Bock but incorporating material from an unpublished MS. written by Miller about 1915. The zygodactyl arrangement of the toes is shown to be an adaptation for perching rather than for climbing as is often stated. Only in the wrynecks, piculets, and "ground woodpeckers," which relatively seldom climb on vertical trunks, is the toe arrangement functionally zygodactyl. Truly scansorial woodpecker feet are divided into a "short hallux" and a "long hallux" group. Miller's term "ectropodactyl" is advocated for the toe arrangement in the functional scansorial woodpecker foot. The evolution of various perching and climbing foot-types is postu-

lated and diagrammed. There are several foot-types in each category. Whereas each type developed as a functional adaptation, the existing differences between foot-types within a category (perching or climbing) have a phylogenetic rather than an adaptive origin.—K. C. P.

HAMILTON, T. H. 1958. Adaptive variation in the genus *Vireo*. Wilson Bull., **70**: 307–346.—The species of *Vireo* inhabiting North and Middle America are compared, and the intraspecific variation of some species is studied. Sympatric species occupy different plant associations or different strata of the same association. Longest wing lengths within species occur in populations of hot, arid regions; shortest occur in hot, humid regions; and intermediate lengths occur in cold regions. These results appear to conflict with Bergmann's rule. Migratory forms have more pointed wing-tips than resident forms. Tail length is positively correlated with wing length, and bill length is less so. Pigment variation supports Gloger's rule. *V. flavifrons* is considered to have evolved from *V. solitarius*, the two species now inhabiting different habitats and winter ranges. The variations in *Vireo* are compared with those in other genera.—J. T. T.

SAVILE, D. B. O. 1958. The loon wing. Evolution, **12**: 263.

SIBLEY, C. G., and D. A. WEST. 1958. Hybridization in the Red-eyed Towhees of Mexico: the Eastern Plateau populations. Condor, **60**: 85–104.—Use hybrid index between *Pipilo erythrophthalmus* and *P. ocai* with 6 plumage differences, and then give five gradations between each pure species. In this fashion a series of specimens is evaluated from critical areas of hybridization in central Mexico. In one area the two species are sympatric but hybridization occurs, yet in another area of sympatry no hybridization has been found.—D. W. J.

SNOW, D. W. 1958. Climate and geographical variation in birds. New Biology, **25**: 64–84.—A good discussion of the "ecogeographical rules."—E. E.

STORER, R. W. 1958. Loons and their wings. Evolution, **12**: 252–263.—In commenting on an article on adaptive evolution in birds' wings by D. B. O. Savile, Storer points out that loons are not relatives of the Hesperornithes. The present form of the wings of loons is stated to be a modification permitting swift flight despite a high wing-loading.—J. C. H.

General Biology

LEFEBVRE, E. A., and J. H. LEFEBVRE. 1958. Notes on the ecology of *Dactylortyx thoracicus*. Wilson Bull., **70**: 372–377.—Notes on the Singing Quail's habitat in Tamaulipas, Mexico, voice, behavior, and feeding.—J. T. T.

MCNALLY, J. 1957. The feeding habits of cormorants in Victoria [Australia]. Victoria Fish and Game Dept. Fauna Contrib., no. 6: 1–36. Stomach contents and feeding methods of the following: *Phalacrocorax carbo, P. sulcirostris, P. varius, P. melanoleucus, P. fuscescens,* and *Anhinga novae-hollandae*. Weights by sexes are also given.

MEANLEY, B., and R. I. MITCHELL. 1958. Food habits of Bachman's Warbler. Atl. Nat., **13** (4): 236–238.—Stomach contents of 14 examples taken between 1905–1916, and feeding behavior.—E. E.

MIDDLEMISS, E. 1958. The Southern Pochard *Netta erythrophthalma brunnea*. Ostrich, Suppl. **2**: 1–34. African Wildfowl Enquiry. Rept. no. 1.—A full account of what is known about the African race of a duck, the nominate race of which breeds in South America.—E. E.

MOHR, H. 1958. Ein Fall von Polygamie bei der Rauchschwalbe (*Hirundo rustica*).

Orn. Mitteil., 10: 7–9.—Two pairs of European Barn Swallows nested in a barn near Wetzlar, Germany. On the death or disappearance of one male, the other male helped to feed the young in both nests, and apparently fathered a second brood of each female—said to be an unprecedented case of polygyny in this species. (In German.)—E. E.

NICKERSON, B. 1958. Some observations on the Carmine Bee-eater *Merops nubicus* Gmelin in the French Sudan. Ibis, 100: 454–457.—The association between this bee-eater and flocks of locusts is described. Flocks of the birds follow the locusts; nesting grounds may be determined by the locality of locust concentrations rather than presence of optimum nesting substrate.—J. W. H.

NØRREVANG, A. 1958. On the breeding biology of the guillemot (*Uria aalge* (Pont.)). Dansk Ornith. Foren. Tidsskr., 52: 48–74.—A detailed study of the breeding behavior of the Common Murre on the Faroes. It contains much ethological data, and a comparison with the reported behavior of Brünnich's Guillemot (Thick-billed Murre). (In English.)—E. E.

QUAY, T. L. 1958. The foods and feeding habits of the Savannah Sparrow in winter. Jour. Elisha Mitchell Sci. Soc., 74 (1): 1–6.—Stomach contents of 200 specimens from vicinity of Raleigh, North Carolina.—E. E.

ROBERTSON, W. B., JR. 1958. Investigations of Ring-necked Pheasants in Illinois. Ill. Dept. Cons., Tech. Bull., No. 1: 1–137. Springfield, Illinois.—First of a series of technical bulletins of the Illinois Department of Conservation. Illinois pheasant range is agricultural land used for dairy farming and grain crops in the glaciated northeastern area. The paper includes data on seasonal behavior, weights, age and sex ratios, brood sizes, nesting, population trends, ecology, hunting and management. The author believes that two factors work in a complementary fashion to prevent successful establishment in southern and western Illinois: lack of sufficient calcium grit in the soil and too high preincubation temperatures.—E. E.

ROBINSON, R. H. 1958. Use of nest boxes by Wood Ducks in the San Joaquin Valley, California. Condor, 60: 256–257.

SCHNELL, J. H. 1958. Nesting behavior and food habits of Goshawks in the Sierra Nevada of California. Condor, 60: 377–403.—This study entails a careful, detailed report of a nesting pair of Goshawks. Included in the report are matters relating to prey items (mostly small birds), caching of adults, male and female behavior, development of the young, and feeding of young. From hatching until two nestlings left the nest (49 days), the total estimated weight of prey consumed was 13,000 gms. When these birds left the nest, one weighed about 850 gms. and the other about 600 gms.—D. W. J.

SICK, H. 1958. Geselligkeit, Schornstein-Benutzung und Überwinterung beim brazilianischen Stachelschwanzsegler *Chaetura andrei*. Vogelwarte, 19: 248–253. The social behavior, use of chimneys and wintering roosts of the swift, *C. andrei*, in the state of Rio de Janeiro, Brazil. While only a single nest is usually placed in one chimney, the pair is often accompanied by companions, as has been reported for the North American Chimney Swift (*C. pelagica*). Large flocks were found roosting together in winter. (In German.).—E. E.

SICK, H. and J. OTTOW. 1958. Vom brasilianischer Kuhvogel, *Molothrus bonariensis*, und seinen Wirten, besonders dem Ammerfinken, *Zonotrichia capensis*. Bonn. Zool. Beitr., 9: 40–62. An important study of the Shiny Cowbird and its hosts (particularly the Rufous-collared Sparrow) in Brazil. Althought the cowbird often punctures the eggs of its host, a considerable proportion of sparrows hatch in parasitized nests and are successfully fledged. (In German.)—E. E.

SKUTCH, A. F. 1958. Roosting and nesting of Araçari Toucans. Condor, **60**: 201–219.—This account adds much to life history data concerning these elusive birds. For the two species, *Pteroglossus torquatus* and *P. frantzii*, both of which inhabit parts of Central America, there is a discussion relating to food, voice, roosting, nesting, and care of fledglings. Emphasis is placed upon roosting; these species occupy woodpecker holes or other natural cavities. As many as five or six birds roost together, sometimes with nestlings.—D. W. J.

SLADEN, W. J. L. 1957. Penguins. Scientific American, **197**: 44–51.—A popular account presenting information about the distribution of this group of birds, and their reproduction, food habits, ecology, sounds, longevity, health, and adaptations to extreme cold.—J. C. H.

SLADEN, W. J. L. 1958. The Pygocelid penguins. I. Methods of Study. II. The Adélie Penguin *Pygoscelis adeliae* (Hombron & Jacquinot). Falkland Islands Dependencies Survey, Sci. Rept., no. 17: 1–97, 12 photo. pls. Price, 47 s. 6 d. F. I. D. Sci. Bureau, 22 Gayfere St., London S. W. 1, England. A detailed and interesting study of the biology of the Adélie Penguin made in 1948, 1950, and 1951, with the aid of marked birds and motion picture photography. At the start of the breeding season the birds walk some 200 miles from open water (the source of food) to the rookery. Each member of the pair makes two long fasts during the breeding season, the longer fast of the male lasting continuously for about 40 days.—E. E.

SOUTHERN, W. H. 1958. Nesting of the Red-eyed Vireo in the Douglas Lake Region, Michigan. Jack-Pine Warbler, **36**: 105–130, 185–207.—An elaborate study, based on numerous nests, treating sizes of territory, defense behavior, location, size and construction of nests, incubation periods, clutch size, development and care of young. There are useful tables showing nesting success, and comparing nesting data in many species of *Vireo*. The author believes only the female incubates, although the male (which has no brood patch) sometimes sits on the nest.—E. E.

STONEHOUSE, B. 1956. The Brown Skua *Catharacta skua lönnbergi* (Mathews) of South Georgia. Falkland Islands Dependencies Survey, Sci. Rep., no. 14: 1–25, 2 photos. pls. Price, 10 s. F. I. D. Sci. Bureau, 22 Gayfere St., London S. W. 1, England.—Habitat, behavior, breeding biology, comparison with allied species, and taxonomy.

USPENSKI, S. M. 1958. The bird bazaars of Novaya Zemlya. Translations of Russian Game Repts., **4**: 159. Dept. North Aff. and Natl. Res. Canada. Price $1. A translation by J. M. MacLennan of a Russian book published in 1956. The nesting colonies of Arctic sea-birds known locally as "bird bazaars" are exploited for food in the Soviet Union. This study was made to determine methods for providing an annual "crop" of eggs and meat. This required study of the biology of the chief nesting species: *Uria lomvia, Cepphus grylle, Plautus alle, Uria aalge, Fratercula arctica,* and *Rissa tridactyla,* and of an important predator, *Larus hyperboreus*—of interest to ornithologists.—E. E.

WARHAM, J. 1958. The nesting of the Little Penguin *Eudyptula minor*. Ibis, **100**: 605–616.—Observations on breeding behavior were made at Cat Island, off southern Australia. Two pairs and their broods are the basis for most of the information presented. When the chicks are guarded the adults alternate their time at the nest, the relieving bird feeding the chicks upon arrival. Chicks leave the burrow at about 23 days of age, become independent, and go to sea between 56 and 60 days of age. Displays of this species are described and in most cases they are

analogous to those of New Zealand and Antarctic penguins. Coition occurs freely in the nesting period and recurs at the time of molt. Non-breeding individuals are the first to molt.—J. W. H.

WARNCKE, K., and J. WITTENBERG. 1958. Eizahl des Kuckucks. Vogelwelt, 79: 20–22.—The number of eggs laid by the parasitic Cuckoo (*Cuculus canorus*) in one breeding season. (In German.)—E. E.

MIGRATION AND ORIENTATION

COCHRAN, W. W., and R. R. GRABER. 1958. Attraction of nocturnal migrants by lights on a television tower. Wilson Bull., 70: 378–380.—Nocturnal migrants approached the red lights from different directions and circlel. Judged by the number of calls heard, birds were more numerous near the tower than one or two miles away and were more numerous when the lights were on than when they were off.—J. T. T.

MCCLURE, H. E. 1958. Dispersal of egrets on the Kanto Plain, Japan. Wilson Bull., 70: 359–371.—The annual variation in the egret (three species of *Egretta*) population of the area is described. Dispersal of young egrets from breeding colonies brings peak density in the rice fields in August and September, coinciding with the peak of encephalitis infections in the area. Notes on other ardeids are included.—J. T. T.

OLSSON, V. 1958. Dispersal, migration, longevity and death causes of *Strix aluco, Buteo buteo, Ardea cinerea* and *Larus argentatus*. A study based on recoveries of birds ringed in Fenno-Scandia. Acta Vertebratica, 1, no. 2: 89–189. Price, 20 Swedish kronor. Nordiske Museet and Skansen, Stockholm, Sweden. The banding data on four common species with different migration tendencies were studied. A good bibliography of pertinent European literature is included. The Tawny Owl, a sedentary species, shows a radial dispersal by young birds. The nominate race of the Common Buzzard, *B. b. buteo*, concentrates in large flocks that leave the Scandinavian Peninsula to follow a narrow path southwestward over western Europe. Young Common Herons disperse after fledging, with the more northern-bred birds moving predominantly northwards; after this late summer dispersal the entire population migrates out of Scandinavia. Two breeding Herring Gull populations have different winter ranges. Ages of the oldest banded birds recovered: Tawny Owl (10–11), Common Buzzard (17–18), Common Heron (18–19), Herring Gull (16–17). Falling of worn bands and failure to return illegible bands make for disproportionately fewer recoveries of older birds.—E. E.

PHYSIOLOGY

ASSENMACHER, I. 1958. La mue des oiseaux et son déterminisme endocrinien. Alauda, 26: 251–289. A lucid and useful review and synthesis of published data on the endocrine basis of molt in birds, with an extensive bibliography. The thyroid gland is believed to be most important in producing molt. While sex hormones, in some species, affect the form and color of the new feathers or may give molt its cyclical character, in many species molt occurs without regard to the stage of the gonadal cycle. (In French.)—E. E.

NAMAKURA, T. 1958. Seasonal changes of thyroid gland and gonads of the Japanese Tree-Sparrow. 3. On the thyroid activity in seasons based on the histology. Misc. Rep. Yamashina's Inst. for Orn. and Zool., no. 12: 22–23. The month by month activity of the thyroid gland, as indicated by the sectional areas of

epithelial cells, follicles and colloidal part. (In Japanese; table, fig., and summary in English.)—E. E.

STEEN, J. 1958. Climatic adaptation in some small northern birds. Ecol. **39:** 625–629.—Freshly caught wild birds exposed experimentally to temperatures down to —25°C. maintained a lower body temperature and lower rate of oxygen consumption overnight compared with birds acclimatized for one week at —10°C. —S. C. K.

TAXONOMY AND PALEONTOLOGY

BRODKORB, P. 1958. Fossil birds from Idaho. Wilson Bull., **70:** 237–242.—Three new species—a cormorant, a swan, and a rail—are described and others are listed and commented upon.—J. T. T.

BRODKORB, P. 1958. Birds from the Middle Pliocene of McKay, Oregon. Condor, **60:** 252–255.—A collection of avian fossils from this area revealed the following forms: *Nettion bunkeri, Lophortyx shotwelli* (new species), and *Bartramia umatilla* (new species).—D. W. J.

CLANCEY, P. A. 1958. Taxonomic notes on two southern African species of Paridae. Ibis, **100:** 451–454.—It is proposed that *Parus niger* be divided into two subspecies, *P. n. niger* and *P. n. xanthostomus*, the latter epithet available from Shelley 1892. *P. afer cinerascens*, it is further proposed, is divisible into two distinct races: *P. a. cinerascens* and *P. a. intermedius*, the latter epithet being already available from Shelley 1900. *P. a. damarensis* Reichenow thus would be a synonym *of P. a. cincerascens*.—J. W. H.

CLANCEY, P. A. 1958. Geographical Variation in the Fairy Flycatcher. Ostrich, **29:** 112.—*Stenostira scita* of South Africa.

ELGOOD, J. H. 1958. A new species of *Malimbus*. Ibis, **100:** 621–624.—A new weaver, family Ploceidae, is described and named *Malimbus ibadanensis*. Known only from the area of Ibadan, Nigeria, it is much like *M. cassini*, but the female is entirely black, and the male has more red on the breast. The new species is described, and its habitat, behavior (including nesting), food, relationships with other species of the genus are given. Possibility of hybrid origin is mentioned but largely discredited.—J. W. H.

ESCALANTE, R. 1958. The subspecific identity of the Oystercatcher in Uruguay. Condor, **60:** 191–192.

GRANT, C. H. B. 1958. Ornithological nomenclature and nomenclatorial procedure. 26 pp. Caxton Holmesdale Press, 24 South Park, Sevenoaks, England.—A set of proposals for ornithological nomenclature, published posthumously by the author's friends. Captain Grant was a believer in strict priority starting with Jan. 1, 1758, had no patience with *nomina conservanda*, and opposed emendations even when the intended spelling appeared in the same publication (unless expressly stated to be a correction). His views certainly do not accord with the International Rules, though in most points they agree with the A.O.U. Code.—E. E.

HOWARD, H. 1958. Further records from the Pleistocene of Newport Bay Mesa, California. Condor, **60:** 136.

HOWARD, H. 1958. An ancient cormorant from Nevada. Condor, **60:** 411–413.

HUMPHREY, P. S. 1958. Classification and systematic position of the eiders. Condor, **60:** 129–135.—The author amasses evidence from a study of tracheal structure, plumage, food, and diving habits to propose eiders should belong to a separate Tribe Somateriini, next to the Anatini. *Lampronetta* is placed in the genus *Somateria*, while *Polysticta* is retained as a separate genus.—D. W. J.

HUSAIN, K. Z. 1958. Subdivisions and zoogeography of the genus *Treron* (Green Fruit-Pigeons). Ibis, **100:** 334–348.—These pigeons, which early were grouped into as many as six genera, later reduced to three or four, and most recently regarded as a single genus, are regarded as composing a single genus here, but one with several natural categories above the specific. The author recognizes and describes the genus, two subgenera, five species-groups, two super-species, and twenty-one species. *Sphenurus formosae australis* (McGregor 1907) is invalid because of *T. a. australis* (Linnaeus 1771). The author proposes that the former be renamed *T. f. mcgregorii* (nom. nov.). Species of *Treron* in Africa may have evolved from an Oriental dry-country form or an Oriental evergreen-forest form. In the latter case, the Oriental dry-country form, *T. phoenicoptera*, was derived from the form of the north African savanna in the period from late Miocene to late Pliocene.—J. W. H.

MACKWORTH-PRAED, C. W. 1958. The correct name of the Peregrine Falcon. Bull. Brit. Orn. Club, **78:** 149.—Contends that *Falco japonensis* Gmelin, 1788, should be adopted because of page priority. (*Cf.* Holthuis and Junge, Ardea, **46:** 167–170, 1958).—E. E.

MAINARDI, D. 1958. I gruppi sanguini degli uccelli ed il loro valore nella moderna sistematica. Riv. Ital. Orn., **28:** 114–124.—The blood groups of birds and their value in modern systematics. Contains a useful bibliography, much of it from non-ornithological journals. (In Italian.)—E. E.

MAINARDI, D. 1958. La filogenesi nei Fringillidi basata sui rapporti immunologici. Inst. Lombardo Scienze e Letteri (Milano), Rendiconti, Cl. Sci. (B), **92:** 336–356. (In Italian, with English summary.)—Serological examination of the red blood cells of 9 key species shows close relation between Estrildinae and Passerinae, and between Emberizinae and *Fringilla*, with the Carduelinae standing in intermediate position between these two major groups. The analysis agrees closely with the arrangement of Tordoff based on the skull, and in part with that of Stallcup.

MAYR, E. 1958. The sequence of the songbird families. Condor, **60:** 194–195.

MOYNIHAN, M. 1959. A revision of the family Laridae (Aves). Amer. Mus. Novit., **1928:** 42 pp.—This paper is an example of applying results of comparative behavior studies to taxonomy; morphological characters used are chiefly those of Dwight and von Boetticher. Behavior patterns and displays mentioned by name are not described or analyzed; references are given to earlier papers covering these matters. In large part, Moynihan has moved the existing classification down one notch in the hierarchy. The family Laridae is considered to include the skuas (given subfamily status) and the skimmers (given the status of a third tribe, along with the gulls and the terns, within the subfamily Larinae). Genera are greatly expanded. Except that in the "Sternini" Moynihan admits *Larosterna* and *Anoüs* (including *Procelsterna* and *Gygis*) as well as *Sterna*, his genera are exactly equivalent to his tribes. Within these large genera he admits numbered "groups," most of which are equivalent to currently recognized genera. Taxonomic innovations also include some regroupings of sequence of species within genera. Species relationhips are discussed in a few cases.—K. C. P.

PARKES, K. C. 1958. Specific relationships in the genus *Elanus*. Condor, **60:** 139–140.

RAND, A. L., and M. A. TRAYLOR, JR. 1959. Three new birds from West Africa. Fieldiana, Zool., **39,** no. 25: 269–273. The following new races are described *Polipicus elliotii gabela*, Gabela, Angola; *Nectarinia superba nigeriae*, Ifon,

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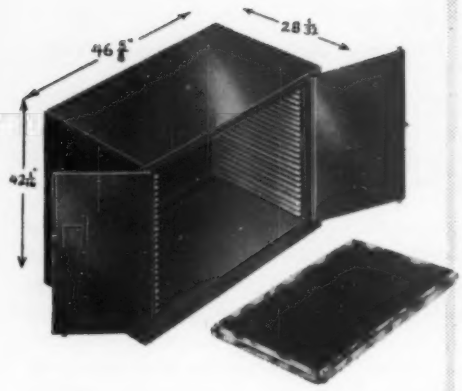
Erratum—'The Auk,' **76** (2), p. 256, April, 1959, next to last line on the page: Substitute "MEANLEY, B." for "SCHMID, F." (see correction Atl. Nat., **14** (1): 58, 1959).

Dr. Herbert Friedmann was awarded the Daniel Giraud Elliot Medal at the April, 1959, meeting of the National Academy of Sciences for his monograph "The Honeyguides" (U. S. Natl. Mus. Bull., **208**, 1955).



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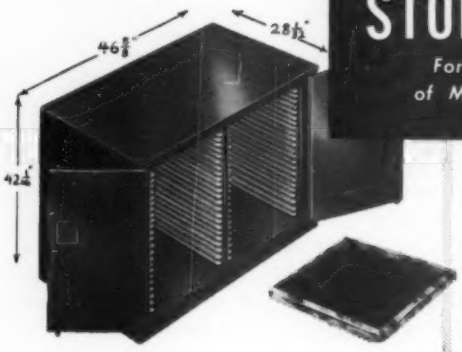

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